I N D I C E

Nº INTERNO	ARCHIVO	DOCUMENTO
402	5-D-11	Manual de Guerra Electronica de la NAVY.
403	5-D-12	Informe de la Comisión Especial de Análisis y evaluación del empleo de la I.M. en el conflicto con G.B.

C. O. A. C.
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C. O. A. C.
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CLASIFICADO

MANUAL DE GUERRA
ELECTRONICA DE
LA US NAVY

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NWP 33 (Rev. F)

C.O.A.C.
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CLASIFICADO

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EJEMPLAR Nro. 10

DEPARTMENT OF THE NAVY
OFFICE OF THE CHIEF OF NAVAL OPERATIONS
WASHINGTON, D.C. 20350

January 1978

1. NWP 33 (Rev. F), ELECTRONIC WARFARE (U), is a Secret naval warfare publication. It shall be safeguarded in accordance with the Department of the Navy Information Security Program Regulations (OPNAVINST 5510.1).

2. NWP 33 (Rev. F) is effective upon receipt and supersedes NWP 33(E), ELECTRONIC WARFARE (U), which shall be destroyed in accordance with OPNAVINST 5510.1.

3. NWP 33 (Rev. F) in conjunction with NWP 32 (Rev. G) supersedes NWP 31(B), ANTISHIP MISSILE DEFENSE (U), which shall be destroyed in accordance with OPNAVINST 5510.1.

4. Disclosure of this publication or portions thereof to foreign governments or international organizations shall be in accordance with NWP Ø.

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CLASSIFIED BY: DIRECTOR ANTISUBMARINE WARFARE
AND OCEAN SURVEILLANCE PROGRAMS.

REVIEW ON 1 JAN 1998

PUBLICATION NOTICE

ROUTING

1. NWP 33 (Rev. F), ELECTRONIC WARFARE (U), is available in the Naval Warfare Publications Library.

2. This publication has been converted to the numeric numbering system to facilitate the use of automated word processing equipment.

3. This publication has been updated in its entirety.

4. New Appendix B, Employment Procedures, is added to the publication.

5. Appendix E is identical to the Reporting appendix contained in NWP 32 (Rev. G).

6. This revision of the publication incorporates the urgent change dated 5 October 1977.

Naval Warfare Publications Custodian

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Note to Naval Warfare Publications Custodian

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RECORD OF CHANGES

Change No.	Date of Entry	Page Count Verified by (Signature)

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Change No.	Date of Entry	Page Count Verified by (Signature)

PREFACE

NWP 33 (Rev. F) provides approved policy, tactics, and procedures for electronic warfare (EW), and is the guide for the planning and execution of EW in naval operations. ACP 178, Maritime Electronic Warfare Instructions, and ACP 179, Electronic Warfare Instructions for Air Forces, provide additional basic EW procedures for U.S. use, and govern the planning and execution of EW in Allied operations.

Tactical deception, treated in this publication as a phase of EW, is given broader coverage in NWP 34, Naval Operational Deception (U).

References to other publications imply their effective editions. In changes, new or modified information will be indicated by a vertical line in the adjoining margin.

RECOMMENDED CHANGES

Recommended changes to this publication may be submitted at any time using the accompanying sample letter format. Atlantic fleet units and stations submit recommendations to:

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Officer in Charge
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Washington, D.C. 20374

URGENT CHANGE INFORMATION

When items for changes are considered to be of vital importance, including matters of safety, this information shall be sent by message (see accompanying sample message format) to Commander, Second Fleet, with information copies to CNO, Naval Safety Center, Navy Tactical Doctrine Activity, and all other commands concerned, clearly explaining the proposed change. Information addressees should comment as appropriate. See NWP Ø .

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a. Page Article/Para. No. Line/Sentence Figure No.

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URGENT CHANGE RECOMMENDATION FOR NWP 33

A. NWP Ø
B. AS REQUIRED
1. IAW REF A, URGENT (SAFETY) CHANGE IS RECOMMENDED FOR NWP 33.

2. PAGE ________ ART/PARA. ____ NO. ____ LINE/SENTENCE ____
FIG. NO. ____

3. PROPOSED NEW TEXT

4. JUSTIFICATION

CHAPTER 1

Concept of Naval Electronic Warfare

1.1 SCOPE OF ELECTRONIC WARFARE

Electronic warfare (EW) involves activity, both passive and active, throughout the entire electromagnetic spectrum. Although the field of acoustics is not normally included in the term electronic warfare, it is recognized that acoustic emissions, intentional or unintentional are an inseparable aspect of the total emission management problem. Management of EW must be integrated into the command and control structure to ensure that EW actions are planned and executed as an integral part of military operations. EW involves employment of equipment, systems, tactics, and techniques for the purpose of:

1. Determining hostile activity in the electromagnetic spectrum
2. Countering hostile use of the spectrum
3. Optimizing friendly use of the spectrum.

Figure 1-1 shows the functional relations of EW operations.

1.2 DEFINITIONS

Electronic warfare (EW) is military action involving the use of electromagnetic energy to determine, exploit, reduce, or prevent hostile use of the electromagnetic spectrum and is action which retains friendly use of the electromagnetic spectrum. There are three divisions within EW.

EW support measures (ESM) is that division of EW involving actions taken under direct control of an operational commander to search for, intercept, identify, and/or locate sources of radiated electromagnetic energy for the purpose of immediate threat recognition. Thus, ESM provides a source of information required for immediate decision involving electronic countermeasures (ECM), electronic counter-countermeasures (ECCM), avoidance, targeting, and other tactical employment of forces.

Electronic countermeasures (ECM) is that division of EW involving actions taken to prevent or reduce an enemy's effective use of the electromagnetic spectrum. ECM includes:

1. Electronic Jamming — The deliberate radiation, re-radiation, or reflection of electromagnetic energy with the object of impairing the use of electronic devices, equipment, or systems being used by an enemy.

2. Electronic Deception — The deliberate radiation, re-radiation, alteration, absorption, or reflection of electromagnetic energy in a manner intended to mislead an enemy in the interpretation or use of information received by his electronic systems. There are two categories of electronic deception:

   — Manipulative electronic deception — The alteration or simulation of friendly electromagnetic radiations to accomplish deception.

   — Imitative electronic deception — The introduction of radiations into enemy systems which imitate his emissions.

Electronic counter-countermeasures (ECCM) is that division of EW involving actions taken to retain friendly effective use of the electromagnetic spectrum.

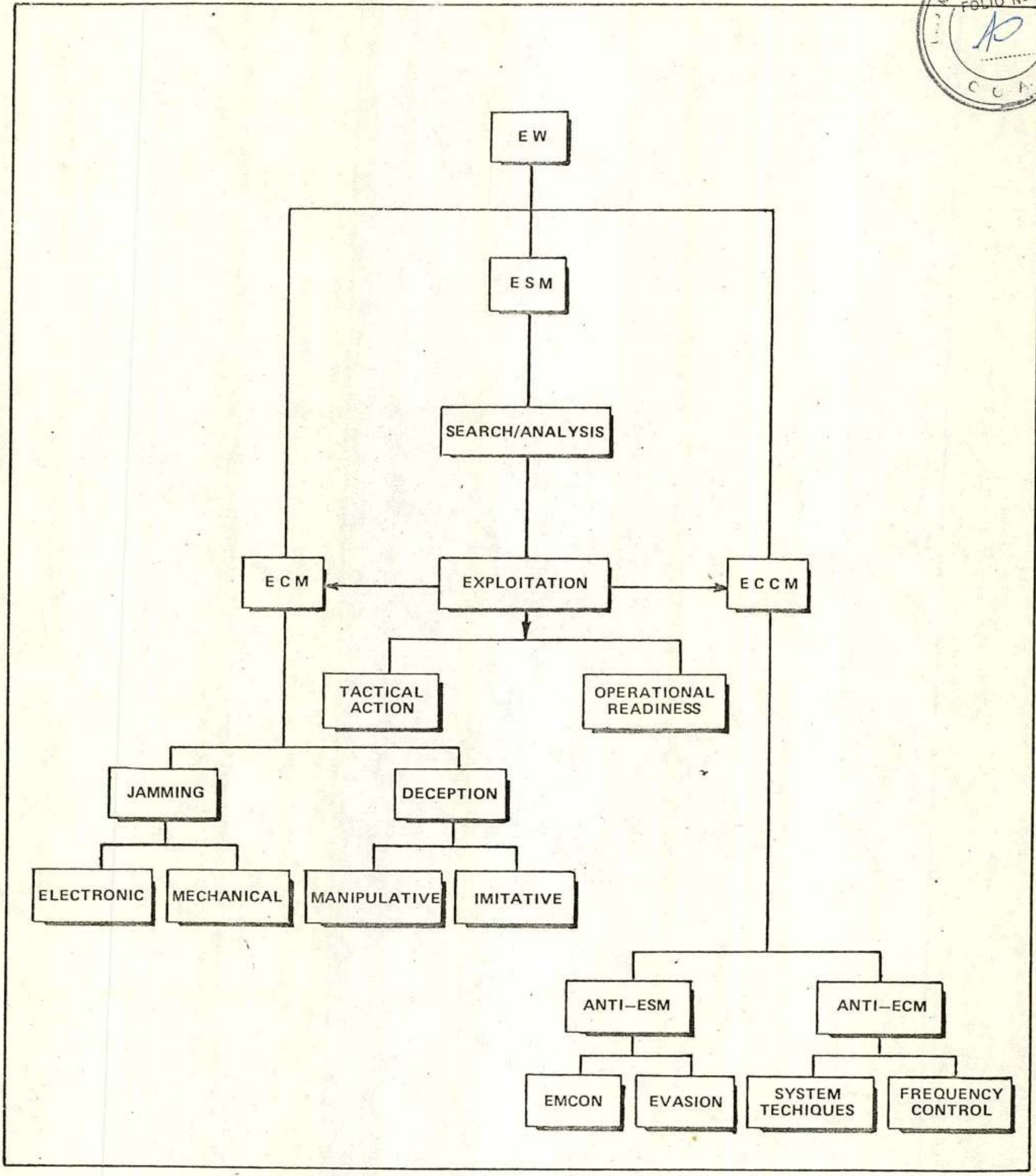

Figure 1-1. Functional Relations of EW Operations

1.3 OBJECTIVE OF ELECTRONIC WARFARE

The objective of naval EW is to ensure the continuing freedom of the seas by providing operational commanders with an integrated capability to take action using the electromagnetic spectrum, to be aware of hostile intent, to counter hostile action, and to protect own or friendly forces.

This objective includes:

1. Determining the existence, location, disposition, and threat potential of all significant weapons, sensors, and communications systems that use electromagnetic radiations.

2. Denying an enemy the effective use of his electromagnetic systems by destroying them, degrading them, or rendering them ineffective.

3. Ensuring the effectiveness and security of fleet electromagnetic capability regardless of intentional or unintentional counteraction from any source.

1.4 REQUIREMENT FOR ELECTRONIC WARFARE

The ever-broadening aspects of electronics, optics, and acoustics and their integral relationship to all types of warfare establishes the foundation of EW. All military evolutions conducted today depend on electronic equipment and radiated electromagnetic, electro-optical, or acoustic* energy. Electro-optics, a relatively new term in EW, is the broad field of science dealing with the production, detection, and use of electromagnetic waves in the optical frequency range; that is, 3×10^{11} to 10^{16} Hz. Electronic subsystems are a part of nearly every weapon system in modern warfare. Effective employment of this equipment can and does determine the success of military engagements. Therefore, EW must be considered as a prime factor in planning and executing all operations involving naval forces.

Modern electronic methods impose an increasingly severe compression of time on action and reaction in warfare. For this reason the electromagnetic spectrum can no longer be segmented by separate operations or organizations. Naval forces must possess a fully integrated awareness of the electromagnetic environment in which they are operating. This awareness must go beyond radar and communications frequencies. It must now extend to all areas of the spectrum where a threat can exist.

The need to maintain adequate security of EW activities will continue as a vital factor in naval operations. This security must assist in advancing national defense while ensuring that it imposes no delay in proper military or state response to any aggressor.

Warfare today and in the future will be waged on a dynamically important battleground, the electromagnetic spectrum. Naval forces require the full support of electronic monitoring capabilities and coordinated effort described herein to gain and maintain U.S. superiority in an EW environment.

*Acoustic radiations contribute to the Navy shipboard environment and must be considered in a manner similar to electromagnetic radiations. Acoustic sensing, deception, and limitation of radiation are treated in this publication and ATP 28.

CHAPTER 2

Policy and Control

2.1 (C) EW POLICY

(C) Fleet EW will be maintained as a dynamic and progressive program by all command levels to provide effective naval support to national security and international relations and to ensure continuing freedom of the seas.

(C) It is essential that all echelons of command possess a thorough knowledge of potential threats which exist in the electromagnetic spectrum in order that vigorous prosecution of countermeasures or protective measures can be initiated which will maintain the highest possible state of fleet EW readiness.

(C) The following factors will guide all commands and activities in the preparation for and conduct of EW.

2.1.1 (C) Signal Security (SIGSEC) is composed of electronic security (ELSEC) and communications security (COMSEC). A major continuing objective of SIGSEC is the denial to the enemy of U.S. capabilities, intentions, tactics, and doctrine, particularly those which can be exploited during wartime. SIGSEC functions are concerned with assessing what vulnerabilities are incurred by opposing force intercept of own force emissions. Each command is directly involved in ensuring the security of its emissions, its signal security. After a decision to emit is made by the force, SIGSEC can provide an assessment of the possibility of opposing force intercept and exploitation of that emission.

(C) SIGSEC units provide continuous monitoring of the force emission profile and, based on enemy presence and capabilities, make viable inputs to force EMCON planning. SIGSEC should produce immediate notification to the OTC of any own force emission that does not conform to the force EMCON plan.

(C) SIGSEC personnel can also provide inputs to operations deception planning as set forth in NWP 34 and provide briefings on the scope and nature of the threat to own force emissions.

(C) A more complete discussion of SIGSEC functions and how SIGSEC is an integral aspect of conducting EW is contained in NWP 5 (Naval Cryptologic Operations).

2.1.2 (C) Emission Control (EMCON). Fundamental to all naval operations is the capability for the preservation of security by means of undetected or deceptive movement. To this end, basic emission policy is to start from a condition of total silence and radiate only those emissions necessary to accomplish the assigned mission. Naval forces must be able to operate under conditions of partial or complete emission silence for extended periods, employing passive or external sensors as the primary source of information. Implicit in this capability is the requirement to provide for effective control of emissions of all types. These emanations, including, for example, lighting, radar, communications, sonar, infrared and electo-optical emissions, machinery noise, and electrical equipment, are all susceptible to exploitation by enemy forces. In addition, they are also capable of manipulation by our own forces to cover our genuine intentions or otherwise deceive hostile forces.

2.1.3 (C) Operational Capability. Fleet operating forces will maintain an integrated and self-supporting ESM capability which will advance the performance and ensure the success of assigned missions. This capability will provide the information necessary to conduct effective ECM and ECCM or to direct tactical action. Additional information to support fleet EW operations will be provided by intelligence activities. When freasible and practicable, without detriment to the primary mission of naval units involved, EW information which becomes available as a result of ESM will be made available to SIGINT* collection activities.

2.1.4 (C) Electronic Warfare Intelligence (EWI) is the product resulting from the collection, evaluation, analysis, integration, and interpretation of all available information concerning foreign nations or areas of operations which are immediately or potentially significant to EW.

1. The intelligence community is responsible for the production and dissemination of all source intelligence and intelligence information pertaining to the support of EW.

2. Tactical commanders will be provided with intelligence and intelligence information to permit a continuing evaluation of the effectiveness of friendly and enemy EW operations.

3. Maximum use will be made of the capabilities of theater electronic intelligence centers in support of EW.

4. Electronic warfare support measures will provide:

— Information and data from all sources, including COMINT and ELINT, to provide direct tactical support to fleet units.

— Guidance concerning electromagnetic collection objectives.

— Coordination in the development of electronic information collection, processing, and dissemination techniques.

*See Chapter 4 for definitions.

2.1.5 (C) Procedures for Development of Tactical Concepts. With the introduction of new, major electronic equipment into the fleet, there is an increasing need to develop advanced concepts for their use within an active fleet environment during early introductory stages. In each such instance, CNO will request assistance as required to obtain the following information.

1. Degree of compatibility between new equipment and existing shipboard EW systems, together with particular limitations and capabilities resulting from combined usage which become apparent with fleet experience.

2. Involvement of advanced tactical concepts in the employment of new equipment/systems which appear promising as a result of fleet operational investigations.

3. Equipment deficiencies which are susceptible to immediate remedial action to follow-on production line equipment.

4. Changes to existing installation policies which appear warranted, resulting from testing present tactics and developments of new concepts.

2.1.6 (C) System Efficiency. The rapid growth of the enemy air and surface-launched missile threat is such that all EW means available must be properly coordinated and brought in full measures to bear against the enemy weapon system. An efficient EW posture can only be achieved when all EW systems and equipment are maintained in peak operating condition by pursuing a vigorous program of preventive maintenance and by regular use of the various testing and calibration facilities avaiable to verify the effectiveness of the preventive maintenance program. The task force commander should be notified immediately if any ship under his tactical command undergoes a change in its EW system status that would result in degrading the EW readiness of the force.

2.1.7 (C) Training. The prosecution of EW involves exceedingly short reaction times. Therefore, equipment maintenance and operational proficiency for readiness against potential enemy forces must be

measured in consideration of this fundamental fact. A primary requirement is the establishment of uniform standards in personnel training to ensure the highest degree of maintenance and operator effectiveness. In general, maintenance training will be accomplished in accordance with existing directives and under the cognizance of BUPERS so as to provide an adequate preplanned personnel base fully capable of maintaining all fleet EW equipment. In general, operator training will be accomplished under the cognizance of the fleet commanders in chief by fleet commanders, type commanders, and operational commanders to the maximum practicable extent with the objective of achieving a high state of readiness at sea.

(C) EW exercises which include ESM, ECM, and ECCM will be planned, scheduled, and conducted by fleet commanders to the maximum practicable extent with the objective of achieving a high state of readiness at sea.

2.1.7.1 (C) Personnel. The growing complexities of EW require that procedures for enlisted training, identification, and periodic proficiency testing be applied for the qualification of personnel assigned EW tasks. Officers assigned EW billets should receive formal instruction in the fundamentals of EW prior to assuming such duties.

2.1.7.2 (C) Exercises. The rapid reaction characterizing EW operations requires that a maximum degree of training be accomplished within a realistic electronic environment provided by active fleet exercises. Training utilizing simulators or simulated signals, together with routine in-port drills, may supplement but cannot substitute for this requirement. Fleet commanders should make full and frequent use of all available ESM, ECM, and ECCM equipment in both surface and air training exercises. They should be jointly scheduled when feasible to provide the highest degree of mutual training support within a "live" surface/air environment. Both radiating and nonradiating training devices and simulators, film, and other EW aids should be employed to augment training both afloat and at shore training sites whenever possible.

2.2 (C) CONTROL

(C) Control is the authoritative direction exercised by a commander through his designated representative or control agency over the operation of EW facilities and installations. In scope, EW control ranges from the broad authority exercised over EW operations by officers on the staff and fleet level to the immediate control of equipment and operators which is exercised by officers on the shipboard level.

2.2.1 (C) Planned Control normally is exercised through the medium of operation plans or orders in which the force and its various components are assigned certain EW tasks to be performed in support of the operation. Control is also exercised through suitable correspondence from appropriate commanders to specific units directing that certain tasks be performed. Generally, all necessary information regarding planned control is set forth in the EW, communications, intelligence, and deception annexes and appendixes of an operation plan or order. Active control is exercised through various methods of communications. During naval operations, control is normally exercised over one of the CI nets or another suitable communication circuit as specified in the applicable operation order.

2.2.2 (C) Tactical Control is required to ensure efficient use of equipment and personnel available to the force. Proper ESM procedures must be followed to ensure maximum interception of enemy electronic activity. Normally, ECM is detectable by the enemy; thus, it must be controlled and carefully coordinated to ensure that it is used when it provides a tactial advantage which may outweigh the advantages of continuing in a silent emission control condition. It is equally important to ensure that ECM does not interfere with other operations of the force such as:

1. Active sensors
2. Communications transmissions
3. ESM
4. Navigation aids
5. Other ECM, including deception
6. Other intelligence activities of own force.

Control of those active techniques used in ECCM is necessary to ensure maximum advantage to own forces. Control of all these functions will assist in the successful accomplishment of the planned operation.

2.2.3 (C) Coordination and Control. Subject to policies established by appropriate higher authority, the OTC must maintain overall control of electronic warfare in a force at sea. The OTC may delegate any or all of his EW control responsibilities, as appropriate, to commanders of detached groups or units. The responsibilities of the OTC include:

1. Establishment of an emission policy and the promulgation of EMCON plans.

2. Promulgation and updating of intelligence on the enemy electronic order of battle (EOB).

3. Promulgation of special instructions to supplement fleet policy and doctrine and provide for modifications to these instructions (for example, deception plans, ASCM plans, ELINT reports, disposition of forces, ESM search guards, time sharing plans).

4. Signal security (SIGSEC).

5. Organization and execution of ECM operations.

6. Evaluation and promulgation of information obtained from the electronic warfare organization, including information obtained from own radar when jammed.

7. Training of forces.

8. Designating an Electronic Warfare Control Ship.

9. Designating an EW Coordination and Control net.

2.2.4 (C) Establishing a Task Force/Group Electronic Warfare Organization. The OTC must have within his force a highly effective quick-reacting organization for the conduct of EW. This organization should include provisions for command and control of available EW assets. Ordinarily the OTC delegates authority for control to members of his staff.

2.2.4.1 (C) Force/Group Electronic Warfare Coordinator (FEWC) is responsible to the OTC for all aspects of electronic warfare. He reports directly to the Force/Group Operations Officer with recommendations regarding the planning, organization, execution, and control of EW operations within the purview of his organization. He is specifically responsible for:

1. Ensuring that EW information is coordinated with all other aspects of naval warfare.

2. Monitoring the overall EW organization to ensure that the assigned responsibilities have been carried out.

3. Promulgating a list of threat emitters and updating it on the basis of the latest intelligence and correlated tactical information.

4. Advising the OTC on assignment of the EW Control Ship (EWCS).

5. Tasking the EW equipment.

6. Ordering the ECM policy and coordinating with other weapon users.

7. Advising the OTC on emission policy, EMCON plans and SIGSEC. (Chapter 9 contains additional information.)

8. Controlling the EW Coordination and Control net. (Appendix E contains additional information.)

9. Coordinating and correlating EW functions with other CIC functions.

2.2.4.2 (C) Force/Group Operations Officer is responsible for the overall conduct, coordination, and control of EW operations. He is immediately senior to the Force/Group AAW Officer and FEWC.

2.2.4.3 (C) Force/Group Antiair Warfare Officer/CIC Officer is responsible for coordinating combat information received from CIC of ships in the TF/TG. He maintains an appropriate display based

on his information and keeps the OTC informed of changes in the tactical situation. His responsibilities as Force Antiair Warfare Coordinator (FAAWC) are delineated in Chapter 2, NWP 32, and include:

1. Controlling electromagnetic radiations of the force in accordance with the orders and directives of the OTC.

2. Detailing ESM and radar guard ships.

3. Controlling the AAW command and reporting nets. In addition, he shall ensure rapid dissemination of threat information derived from EW inputs.

2.2.4.4 (C) Force/Group Command Watch Officer is responsible, on a watch-to-watch basis, for controlling EW assets to the extent deemed appropriate by the OTC.

2.2.5 (C) Electronic Warfare Control Ship

2.2.5.1 (C) Description. The Electronic Warfare Control Ship (EWCS) is the ship from which the FEWC exercises control. If possible, this ship should be the OTC's flagship; if not, the OTC designates an EWCS. Normally, the responsibility should be assigned to the component commander exercising control over the most important aspects of the tactical situation (for example, FAAWC or Surface Subsurface Surveillance Coordinator (SSSC)). The EW equipment fitted in the prospective EWCS is an important consideration; however, the ship selected must have the necessary experienced senior personnel to take on duties of the FEWC.

2.2.5.2 (C) EWCS Functions. To expedite the flow of tactical information to the OTC for quick reaction to threats, EWCS personnel must be aggressive to ensure that all controlled ships adhere strictly to the EW plan. The following paragraphs detail various factors that must be considered in carrying out major functions of the EWCS.

2.2.5.2.1 (C) Assignment and Review of Intercept Guards. Consider the following:

1. Intelligence estimate of expected enemy emissions in the particular geographic area

2. Determination of enemy emissions which constitute a threat to the force

3. Radar guard assignments

4. Capabilities and limitations of own equipment:

— Ship's electronic and weapons capability to counter expected threat in assigned bands

— Passive intercept capabilities of installed receivers and antennas

— Individual ship assignments — such that intercept guard and radar guard assignments are within the same frequency range if units are equipped with pulse blankers. If units are not equipped with pulse blankers, intercept guards and radar guards should not be in the same frequency range.

— Antenna height.

5. Position of particular units within the force:

— Threat axis and expected threats

— Intercept range

— Position for optimum DF capabilities.

2.2.5.2.2 (C) Maintaining and Enforcing EMCON.

1. OTC policy and plans

2. Changes in EMCON conditions.

2.2.5.2.3 (C) Providing OTC with Evaluated EW Information and Recommendations. Receive all reports of intercepted signals and take appropriate action to evaluate them:

1. Ensure intercepted signal is designated.

2. Alert OTC if an intercepted signal is an emergency.

3. Identify and evaluate the intercept by requesting additional signal characteristics from reporting units as necessary.

4. Switch selected units with DF capabilities to the intercepted signal when triangulation is required.

5. Plot or enter into NTDS all reported DF bearings to obtain position, course, and speed of the emitter platform

6. Disseminate all information regarding the intercept to the OTC and units of the force without delay.

7. When sufficient information is obtained, order DF units to resume assigned intercept guards.

8. Take action to scrub or watch intercepts when appropriate.

2.2.5.2.4 (C) Maintaining Current Plot, showing activity in:

1. Surface
2. Subsurface
3. Air
4. SPASUR Ephemeris.

2.2.5.2.5 (C) Issuing Periodic SITREPs to OTC. Include:

1. Intercept guard assignments
2. EMCON violations
3. Summary of rackets evaluated
4. Summary of ELINT data collected and ELINT reports
5. Summary of jamming and/or deception encountered
6. Summary of jamming and/or deception employed.

2.2.6 (C) Individual Shipboard Assignments. The responsibility of the individual unit in an EW organization is to collect, plot, evaluate, and disseminate EW information and to advise the command. Using the guidelines established by the OTC and FEWC, the individual unit provides initial detection and evaluation, DF bearing, signal characteristics, or any other service directed by the FEWC.

(C) The EW section of each ship's CIC doctrine should delineate personnel responsibilities, and specify the manning and utilization of equipment. To realize the maximum benefits from ESM equipment, sufficient personnel must be trained as operators and used in adequate rotation to minimize fatigue and increase efficiency. As a minimum two trained operators should be assigned to each EW watch section.

(C) Also included in the doctrine should be specific processing procedures establishing a data flow path that will facilitate the internal and external transmission of EW information for the maximum in speed, accuracy, and simplicity.

(C) Further, each ship's CIC doctrine should provide instructions to be followed when assigned EW control duties. This must include numbers and duties of personnel, displays, and equipment in addition to those required to accomplish individual ship tasks.

2.2.6.1 (C) Commanding Officer is responsible for overall control of EW operations and for the conduct of all EW operations assigned to the ship by higher authority. He normally delegates EW functions to the Operations Department.

2.2.6.2 (C) Operations Officer is responsible for the conduct, coordination, and control of all EW operations aboard. During ship readiness Condition 1, he may be the evaluator in CIC while the CIC Officer under his direction continues as the direct supervisor.

2.2.6.3 (C) Tactical Action Officer (TAO) is responsible for the safe and proper operation of the combat system in all matters of tactical employment and defense of the unit.

2.2.6.4 (C) CIC Officer

1. During Condition 1 integrates the EW information with other combat information. (The CIC watch officer performs this function during Conditions 2 and 3.)

2. With the assistance of the EW officer, supervises, trains, qualifies, and assigns operations specialists and electronic warfare technicians in matters of EW.

2.2.6.5 (C) EW Officer (EWO) is responsible for:

1. Organization, supervision, and coordination of EW including knowledge of ESM, ECM, and ECCM.

2. Planning and execution of such EW measures as may be ordered.

3. Supervision, training, qualification, and assignment of all EW operators and technicians and assisting in the training of CIC watch officers, operations specialists and other personnel connected with EW operations, including weapons department and communications personnel. This includes training in the use of ECCM fixes available in search and specialized radars.

4. Maintenance of an intraship and intraforce collection, evaluation, and dissemination facility for intercept information.

5. Maintenance of an effective ship's ESM organization capable of executing duties such as intercept search, direction finding, and FEWC within an assigned force.

6. Providing CIC and EW watches with a current electronic order of battle (EOB) for friendly, potential nonfriendly, and enemy forces.

7. Coordination of intercept search as ordered by the FEWC.

8. Advice and assistance to the operations means for the execution and monitoring of available ESM, ECM, ECCM, including means and techniques in use for communications countermeasures, radar countermeasures, acoustic countermeasures, reconnaissance satellite countermeasures, evasion, and deception.

9. Establishment of a rapid and effective means for the execution and monitoring of an emission control plan within the ship.

10. Operation of all EW equipment.

11. Control of the ship's EW operations during readiness Condition 1.

12. Instruction of EW operator and technicians regarding the maintenance of shipboard electronic warfare equipment and the PMS program.

13. Preparation of maintenance routines for EW equipment not covered by the PMS program.

14. Compilation of an equipment log that indicates maintenance effectiveness, and lists harmonics and other spurious responses which may be experienced on certain frequencies during intercept search.

2.2.6.6 (C) EW Watch Supervisor

1. Under supervision of the CIC watch officer:

— Supervises the filtering of information for the EW plot.

— Evaluates EW data in the external dissemination.

2. Under supervision of the EW officer:

— Assists in maintaining the EOB.

— Supervises the monitoring of the electronic environment, EW reporting net recorders, EW plotter, status board keeper, and the EW operators.

— Supervises on-watch training.

— Supervises and instructs all EW operators and technicians in the current PMS program for all EW equipment.

2.2.6.7 (C) Intercept Search Operator

1. Conducts an alert search for signals in frequency bands assigned.

2. Analyzes and DFs signals intercepted.

3. Monitors friendly transmissions during EMCON as directed.

2.2.6.8 (C) Assistant Intercept Operator

1. Records characteristics of intercepted enemy transmissions in the electronic intercept log.

2. Keeps equipment ready to record intercepted signals as designated by the EWO.

3. Assists the EW watch supervisor with intelligence publications and information.

4. Operates broad band intercept equipment as required.

2.2.6.9 (C) ECM Operator

1. Keeps the equipment ready in the proper mode for operation as directed by the EW watch supervisor.

2. Records ECM employed against an intercepted signal in the ECM log.

2.2.6.10 (C) EW Reporting Net Recorder

1. Monitors and records information received on the EW reporting nets.

2. Reports to appropriate plotters and the EW watch supervisor.

2.2.6.11 (C) EW Intercept Plotter/Talker

1. Plots all intercepted electronic emissions.

2. Determines course and speed of rackets.

3. Determines triangulated position.

4. Keeps a plot of own and all ships' positions.

5. Determines bearing to racket position from own ship.

6. Relays EW information to other areas of CIC/EW module.

2.2.6.12 (C) Status Board Keeper maintains a display of current EW information and relays it as directed. This information includes:

1. Own ship intercept and radar guard assignments.

2. EMCON in effect.

3. Radiation characteristics of equipment of ships in company and of equipment likely to be intercepted.

4. EMCON violation.

5. ECM employed against enemy equipment.

2.2.6.13 (C) Surface Radar Operator reports all contacts to surface plotters, maneuvering board, surface status board, and DRT.

2.2.6.14 (C) Air Tracker reports all bogey information to air summary plot (vertical and bogey tote).

2.2.6.15 (C) Vertical Plot Plotter

1. Plots bogeys.

2. Plots ESM/ECM information.

3. Plots friendly aircraft.

4. Plots CAP stations.

2.2.6.16 (C) Surface Polar Coordinate Plotter

1. Plots complete current diagram of force.

2. Plots all other surface/subsurface contacts.

3. Plots all ESM.

2.2.6.17 (C) AAW(R) Net Operator

1. Transmits bogey reports to OTC.

2. Receives and plots all bogey reports.

3. Transmits evaluated EW information.

4. Keeps log.

2.2.6.18 (C) AAW(C) Net Talker/Plotter is active during dual net AAW environment.

1. Transmits evaluated information to AAWC.

2. Transmits receipts for force orders.

3. Transmits evaluated/correlated EW information and rent reports.

2.2.6.19 (C) EW Net Talker/Log Keeper

1. Receives all EW information.

2. Transmits evaluated/correlated EW data.

2.2.6.20 (C) PRI CI Operator

1. Transmits and receives surface and subsurface contact information from ships in company.

2. Transmits evaluated EW information.

3. Maintains complete log.

2.2.6.21 (C) Maneuvering Board Plotter maintains the relative plot of own diposition and other friendly and enemy forces in the operating area.

2.2.6.22 (C) CIC Bridge Talker relays information between bridge and CIC.

2.2.6.23 (C) Weapons Officer is responsible for the conduct, coordination, and control of all functions within the weapons department. He is responsible, with the assistance of the EW officer, for the supervision, training qualification, and assignment of all weapons department personnel in matters of EW.

2.2.6.24 (C) Fire Control Officer is responsible to the weapons officer for the conduct, coordination, and control of fire control equipment. He is also responsible for training fire control personnel in ECCM techniques and equipment features of fire control equipment.

2.2.6.25 (C) ASW Officer is responsible for:

1. Coordinating with the engineer and first lieutenant to ensure an effective quiet ship bill.

2. Training sonarmen in various gambits and deception techniques such as random keying of sonar console, alternate use of fanfare, alternate active-passive modes of sonar, and use of underwater telephone as gambit.

3. Advising commanding officer of various acoustic warfare tactics in relation to the use of ASW acoustic equipment.

CHAPTER 3

Operational Concept

3.1 (U) SIGNIFICANCE OF EW IN NAVAL OPERATIONS

Electronic warfare encompasses and is an integral part of all forms of conventional warfare. In some cases, it is also the prime function of unconventional warfare techniques and special naval and marine operations. Consequently, it is of particular significance in all naval operations.

3.2 (U) OPERATIONAL OBJECTIVES

3.2.1 (C) Electronic Warfare Support Measures. ESM provides a source of EW information required to conduct ECM, ECCM, threat detection, warning, avoidance, target acquisition, and homing. Specific objectives of ESM in naval warfare are to:

1. Obtain tactical information concerning the location of enemy weapons and installations

2. Obtain tactical information concerning the location, composition, and movement of enemy units

3. Obtain information concerning enemy intentions and order of battle

4. Provide information which can be used to counter electronically controlled weapons systems

5. Provide information concerning the effectiveness of own force ECM and ECCM activity

6. Provide information on the technical characteristics and probable state of an enemy's electronic potential.

3.2.2 (C) Electronic Countermeasures. Specific objectives of ECM in naval warfare are to:

1. Provide protection against electronically controlled weapons systems

2. Provide protection from enemy gunfire or missiles using electronically actuated fuzes

3. Provide electronic cover and deception for own operations

4. Deny the enemy effective use of his electronic detection, communications and navigational capabilities as well as his intelligence collection effort embodied in shipborne, airborne, satellite and ground-based reconnaissance activities.

5. Influence the enemy's course of action in a manner and at a time most favorable to own commander's plan of action

6. Deny information to a third country, reconnaissance ship, or aircraft which may be present in the area of operations.

3.2.3 (C) Electronic Counter-Countermeasures. Specific objectives of ECCM in naval warfare are to:

1. Reduce chances of discovery by enemy electronic detection and tracking equipment by minimizing the number of electromagnetic transmissions which an enemy might intercept (EMCON)

2. Ensure proper employment of all ship's electronic systems to eliminate mutual interference between receivers and emitters (EMCON)

3. Prevent the enemy from gaining any electronic information which might warn him of an impending engagement (EMCON)

4. Recognize and analyze the enemy's use of ECM

5. Use antijamming techniques and devices to minimize effects of enemy ECM.

3.3 (U) PLANNING

In planning a tactical mission, the commander must consider all aspects of EW including the capability of own forces and that of the enemy. He must promulgate timely directives delegating authority and responsibility and establishing EW policy and plans. Provisions must be established for updating these directives and promulgating the changing intelligence picture which affects the EW posture of the force.

General EW plans are provided in all fleet and force operation orders. When initiating directives are received, the commander, task force (CTF) will prepare a detailed EW plan in accordance with Joint Operation Planning System (JOPS) (JCS SM-597-70) or the appropriate Pacific or Atlantic command implementing directive tailored to the area and enemy expected to be engaged. He will use the basic information provided in current directives and expand the EW objectives in accordance with the expected tactical situation. The plan, besides carefully delineating responsibility and authority, must be flexible to accommodate late intelligence concerning the enemy or his techniques of operations and must be issued in time to enable those responsible to act and make special preparations.

3.3.1 (U) Responsibilities. Successful application of EW requires that responsible officers have a thorough knowledge of the EW capabilities of all units available for the operation. Operational planning is conducted by the CTF with assistance from the various supporting force commanders. Matters on which the force commanders are unable to agree shall be referred to their common superior for a decision.

3.3.2 (U) Requirements. EW plans must provide detailed procedures for accomplishing the objectives specified in paragraphs 3.2.1 through 3.2.3. The selection and training of personnel assigned to EW operations must ensure thorough familiarity with own and enemy electronic systems and EW capabilities. The commander must exploit the capabilities of special EW units of the task force as may be required to accomplish the EW objectives of the operation. Pertinent electronic intelligence data relating to the enemy to be engaged should be incorporated into the operation orders.

3.4 (C) PROCEDURES

(C) The EW appendixes of the operations plans and orders must include detailed plans for all ESM and ECM operations (see paragraph 3.7). Figure 3-1, which is an electronic warfare decision flow diagram, illustrates the process of making a decision in any EW environment.

The CTF initiates requests to appropriate agencies and directives to available units to carry out the following tasks:

3.4.2 (C) Selection of the Engagement Area. If selection of the final engagement area will be affected by the enemy's electronic capabilities, EW planning officers will make recommendations as to area selection so that maximum use of own EW capabilities may be made to counter the enemy electronic installations. Reconnaissance missions must be assigned to gain data on the possible objective areas. In an amphibious landing, studies relative to recommended objectives must be closely coordinated with staff studies of the commander, landing force (CLF).

3.4.3 (C) Studies of EW Requirements and Capabilities. Once the primary and alternate strike/objective areas are firmly established, officers will determine own EW requirements and carefully analyze own capabilities. Periodic reconnaissance

missions may be necessary to confirm prior intelligence and obtain new information on equipment in the objective area.

(C) Close liaison between units is essential during the pre-engagement stage to ensure that agencies conducting the reconnaissance missions are satisfying all requirements. Use of ECM during this stage will be secondary in nature and will consist essentially of actions required by units engaged in reconnaissance missions for their own protection or to encourage the enemy to use certain electronic systems so that intelligence data may be obtained.

(C) A careful consideration of new additional electronic equipment which the enemy is capable of moving to the strike/objective area must be included in this study.

3.4.4 (C) Study of Movement Track. The studies prescribed in paragraphs 3.4.1 through 3.4.3 must be supplemented by a study of the movement track to the strike/objective area. EW planning officers must determine whether own EW capabilities and operating techniques are adequate. If they are found inadequate to accomplish the assigned mission, the precise additional requirements must be determined.

3.4.5 (C) Determination of Force Adequacy. Planning officers must determine whether assigned forces are adequately equipped, manned, and trained to perform the necessary EW tasks. Recommendations must be made for assignment of capable forces for all stages of the operation.

3.5 (C) COORDINATION

(C) Coordination is the action taken by a commander through his designated representative or control agency to bring all EW capabilities of various units and facilities, including those not under his operational control, into concerted action for optimum effectiveness and efficiency. Coordination also includes selection of frequencies compatible to both Navy and Marine equipment as required by the tactical situation. Coordination of all EW information on the ship is the assigned responsibility of CIC.

(C) On the task force or group level, the EW officers who are assigned coordinating responsibility may be stationed in the flagship of the OTC or in another designated ship of the force.

(C) In addition to his duties outlined in paragraph 2.2.4, the FEWC coordinates EW functions with other CIC procedures. For example, he sees to it that the jamming or deception transmissions of one unit do not interfere with air control activities, use of guided missiles, or other necessary operations being conducted by friendly units in the vicinity. Decisions on all such matters involved in the control of EW must be based on sound knowledge of EW; capabilities of the force as a whole; operation plan in effect; and the overall tactical situation, particularly as it pertains to the operation of electronic equipment.

(C) In individual ships of the force, CIC personnel perform EW functions assigned to their particular ships. Close cooperation between personnel assigned to EW duties and other department personnel is necessary to gain maximum advantage from the use of EW. While the operation of ESM intercept receivers is the direct responsibility of EW personnel, the data collected by intercept search are important to all CIC personnel in their task of gathering combat information. In turn, the tactical information which CIC is equipped to gather from other sources is of assistance to the EW officer and to intercept operations. Information from CIC on friendly radars and other electronic equipment operating in the vicinity enables intercept operators to avoid reporting the equipment as unidentified. Information on the bearing of friendly units and of expected contacts helps to center the attention of intercept operators on signals originating outside the force and permits more accurate initial evaluation of new intercept signals. In addition the data furnished by CIC on the location, courses, and composition of enemy forces are vital to the effective employment of any EW tactic, particularly jamming, deception, and evasion.

3.6 (C) TRAINING

(C) Commanders must be aware that the intent of using ECM in an exercise is to provide training to personnel in the use of ECCM and test a unit's capability to operate effectively in an EW environment. Training which provides this experience can minimize the impact of hostile ECM on U.S. fleet operations.

(C) Staff planning and force/unit training will be conducted using EW as an integral part of fleet

operations. Plans should establish the objectives and define the EW applications and requirements that contribute to the objective.

3.6.1 (C) Training Restrictions. All exercises conducted should include EW objectives, activity, and evaluations. The commander directing or coordinating an exercise should consider the following in the planning, control, and coordination of EW.

1. ECM employed during training exercises will be planned, coordinated, and conducted to ensure safety and minimum interference with the electronic activities of agencies or organizations not participating in the exercise.

2. ECM employed during training exercises and maneuvers will be planned and conducted so as to avoid misleading other nations to conclude that hostilities are imminent.

3. ECM/ECCM employed during training exercises and maneuvers will be planned and conducted so as to avoid providing information or training to personnel from nations not privy to U.S. fleet EW equipment, tactics, and techniques.

4. Commanders should consider the Soviet reconnaissance satellite system (ELINT/photo/radar/IR) capabilities when planning training involving sensitive or unique electronic equipment or when covert operations as to unit location is the objective.

5. Specific guidance and procedures related to the employment of ECM/ECCM equipments for operational testing/training are outlined in the current OPNAVINST S3430.4 series, Navy Electronic Warfare Organization and Policy.

3.7 (C) EW APPENDIX TO OPERATION ORDERS/PLANS

(C) The EW appendix is used to promulgate instructions for the use and coordination of electronic tactics and techniques and is included in the operations orders and plans. Guidance in the preparation of the EW appendix (Appendix 3 to Annex C to the basic OPORD/PLAN) can be found in the JOPS (JCS SM-597-70) or the appropriate Pacific or Atlantic command implementing directive.

(C) The EW appendix shall include all necessary instructions pertaining to the operation and control of electronic devices. In preparing the appendix, careful consideration must be given to coordination with all other aspects of naval warfare.

(C) The EW appendix should include the enemy's EOB and other pertinent intelligence data needed for proper operational planning. This information should appear in the form of tabs to the appendix.

(C) The communications annex should make appropriate cross reference to the EW appendix, specifically to conditions of radio silence and meaconing, interference, jamming, and intrusion (MIJI). The communications annex should contain specific procedures to counter communications jamming/deception as well as definitive instructions for alternate means of trasmission for long-range traffic while the TF/TG or HVU is in HF silence. This procedure groups the necessary instructions required by communications officers and eliminates confusion concerning material more clearly the responsibility of the CIC or EW officer.

3.8 (U) REPORTING

As in any operation in which many units may be involved, timely exchange of information is of primary importance. This is particularly true of EW information relating to the current tactical situation when real-time information is required. In addition, messages, logs, photographs, and tape recordings are required for longer-term analysis and countermeasures development.

Appendix E of this publication contains instructions for making EW reports. These procedures may be supplemented as required by fleet commanders to facilitate EW reporting in special operations.

CHAPTER 4

Electronic Warfare Support Measures

4.1 (U) SCOPE OF ESM

Electronic warfare support measures (ESM) is that division of EW involving actions taken to search for, intercept, identify, and locate sources of radiated electromagnetic energy for the purpose of immediate threat recognition.

ESM provides a source of information required for immediate action involving electronic countermeasures, electronic counter-countermeasures, avoidance, targeting, and other tactical employment of forces. Figure 4-1 shows the functional relations of ESM.

ESM can be employed or conducted while remaining electronically silent. This enables a unit or force to gather valuable information concerning the intentions and capabilities of an enemy without radiating its own electronic devices. ESM provides a capability to locate enemy control and weapon systems that use electronic radiations, thereby permitting action to be taken which can deny the enemy the effective use of these systems. Interception, analysis, and evaluation of enemy electromagnetic emissions are the first steps in conducting effective EW.

Cryptologic ESM comprises those ESM functions conducted by cryptologic resources. A complete elaboration of cryptologic ESM is found in NWP 5, Naval Cryptologic Operations.

4.1.1 (C) Method of Conducting ESM. A primary method of conducting ESM is by employing intercept equipment and tactics. This consists of searching for electromagnetic radiations to determine their existence, source, and pertinent characteristics. ESM intercept search is employed to detect electronic emissions radiated from all types of electronic equipment, including radios; radars; electronically controlled weapons and weapons systems; electronic navigation aids; optical, infrared, and ultraviolet devices; and IFF equipment.

(C) Intercept search is also a valuable source of strategic military intelligence. For this reason, appropriate information on enemy electronics collected during ESM operations shall be forwarded for further analysis and evaluation. (See Appendix E.)

4.1.2 Distinction Between ESM and SIGINT. The functions of search, intercept, locating, recording, and emission analysis are common to both ESM operations and SIGINT activities. The distinction is that:

1. ESM operations, including cryptologic ESM operations, are conducted by fleet units as an integral part of the ship/force combat system for the purpose of providing specified combat information. ESM operations are under the direct control of the operational commander.

2. SIGINT operations are conducted for the purpose of developing intelligence information in satisfaction of national and Navy intelligence requirements.

4.1.3 (U) SIGINT Definitions

1. Signal intelligence (SIGINT) is a generic term which includes both communications intelligence and electronic intelligence.

2. Electronic intelligence (ELINT) is the intelligence information product of activities engaged in the collection and processing, for subsequent intelligence purposes, of foreign, noncommunicaitons, electromagnetic radiations

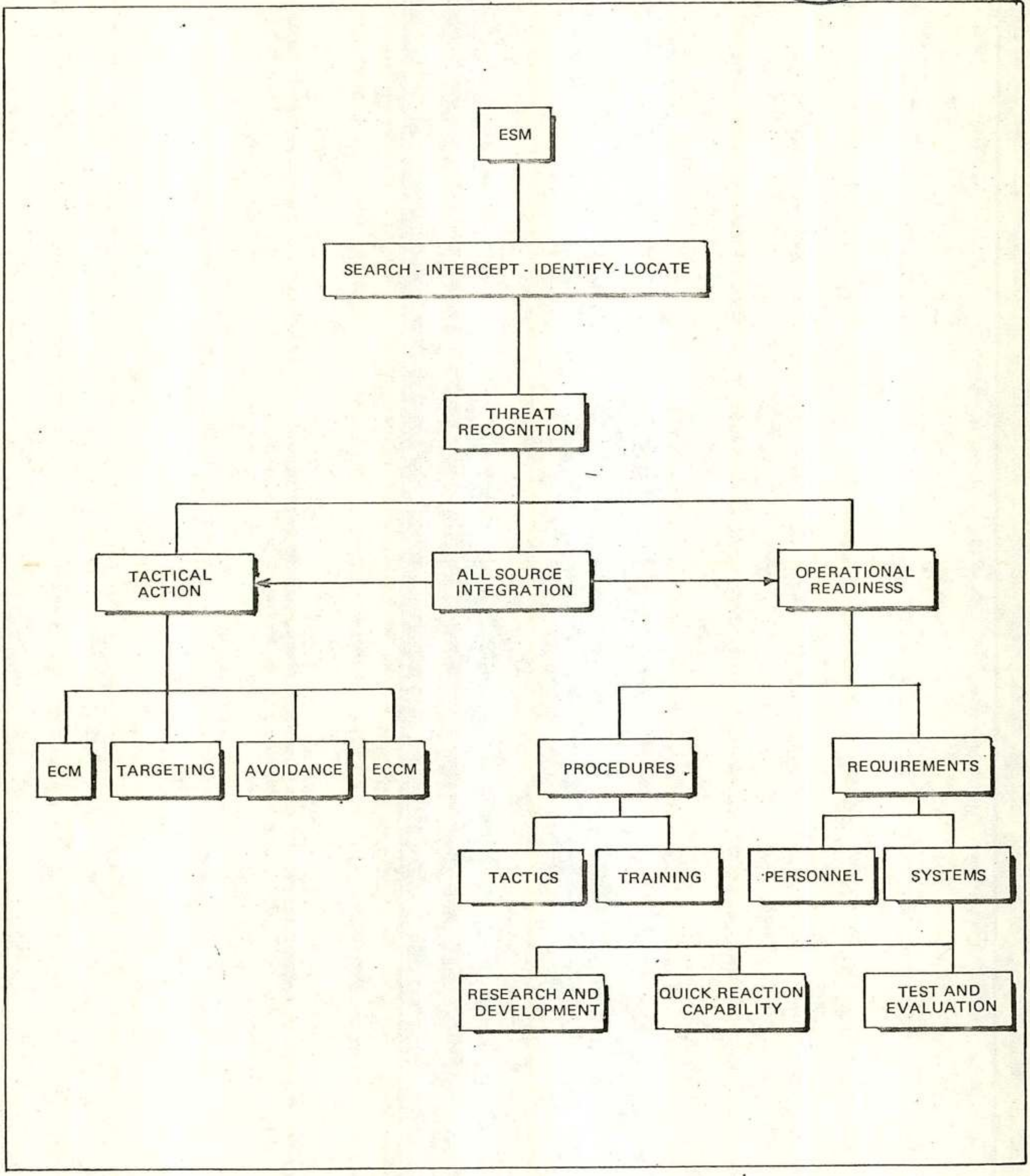

Figure 4-1. (U) Functional Relations of Electronic Warfare Support Measures

emanating from other than nuclear detonations and radioactive sources.

3. Communications intelligence (COMINT) is the technical and intelligence information derived from foreign communications by other than the intended recipients.

4.2 (U) ESM EQUIPMENT

ESM equipment is used to detect, locate, analyze, and record electronic emissions throughout the electromagnetic spectrum. It provides U.S. forces with the capability to gain tactical and strategic intelligence on enemy electronic activity of all types while remaining undetected by the enemy.

Only the basic principles of the general types of equipment used in ESM systems are covered in this section. For information on a specific equipment, the ECM Directory published by the AFEWC should be consulted.

4.2.1 (U) ESM System Sensitivity and Loss Measurements. The fundamental piece of equipment in any ESM system is the intercept receiver. The type of ESM receiver governs the general capabilities and limitations of the system. The overall system is affected by all basic and associated system components.

The gain of an ESM system may be improved for intercept of weak signals by installation of linear preamplifiers. Under conditions where strong signals will be present, however, overloading will occur and the effect on the mission of this reduced dynamic range must be considered. Out-of-band signal leakage into a preamplifier from strong transmitters can also degrade the performance of the system by generating spurious frequencies

To provide maximum detection capability, all system components must be maintained in good condition and interface losses minimized. Alignment and sensitivity performance standards are established for each ESM system.

Frequent inspection of antennas and transmission lines, receiver and system alignment checks, system sensitivity checks, and measurement of system losses are essential to ensure optimum performance of the system.

For accurate analysis of signals, the complete intercept system, from antenna through the recorders, must be checked and calibrated.

Increasing the sensitivity of an ESM system by use of a higher gain antenna, where this can be done, is preferable to the use of preamplifiers; the increased directivity reduces potential spurious frequency generation by discriminating against interferring signals not on the main beam axis of the antenna.

Convenient methods of determining receiver sensitivity are the minimum discernible signal (MDS) method and the tangential sensitivity method. The input signal power is measured, and the sensitivity rating of the system is expressed in decibles relative to a reference signal strength of one milliwatt of power (dBm).

4.2.2 (C) Intercept Receivers. Intercept receivers are classified according to method of searching the frequency spectrum. The basic types are narrow band and wide band. The intercept receiver is used to detect enemy electromagnetic emissions as a function of frequency and to provide selected signal outputs to displays, signal analyzers, recorders, and warning devices. Receivers may be capable of automatic signal processing and identification, thereby providing threat warning for pre-programmed threats. Outputs of these receivers may also be used to automatically gate ECM equipment including deception repeaters and decoy launching devices.

(C) Discrimination circuits which respond to certain signal characteristics may be provided with any receiver to accept or reject appropriate signals for display. Pulse signals which originate on board may be blanked by pulse blanking equipment. A rather elaborate installation is required since the pulse blankers must receive pretrigger pulses from all of own ship's radar transmitters that interfere with the intercept receiver. Own ship's communications signals, which may interfere with COMINT intercepts, may be reduced in their effect through the use of tunable narrow band filters.

(C) For each on-board radar for which blanking is provided, the ESM system is "blind" during, and for a short while after, each pulse. Consequently, the probability of successful intercept of a threat signal is degraded. However, this degradation is insignificant to the advantage gained through elimination of interference. Probability of intercept of a threat signal is enhanced.

4.2.2.1 (C) Narrow Band Receivers are the most common type used for ESM. Normally, they are superheterodyne receivers with excellent selectivity, sensitivity, and stability. Their units have a wide range of frequency coverage but can only accept a narrow band of frequencies at any given time. To provide coverage of the entire frequency range of the receiver, it is necessary to move or tune the acceptance band width. Tuning units (heads) provided for this purpose have a frequency coverage of about one octave (frequency is doubled in one octave), and several tuning heads are used to cover the receiver range. The receiver is manually or automatically tuned through the desired portion of the spectrum

(C) The principal advantage of narrow band receivers is selectivity, which permits signal analysis and recording with a minimum of interference from undesired signals. Additional filters may be employed to increase the capability of the receiver to reject undesired signals. These receivers are also adaptable to operation in conjunction with spot jamming transmitters to determine and set jamming frequencies.

(C) If the frequency of a signal which is to be intercepted is known to an accuracy within the limits of the acceptance band of a narrow band receiver, the necessity for tuning the receiver is eliminated and the probability of signal detection is very high. When it is necessary to search a relatively large portion of the spectrum, the signal detection probability increases with use of rapid scan. Signal detection probability is reduced if it is necessary to shift tuning heads in order to cover the desired portion of the spectrum.

(C) The rapid scanning receiver is a narrow band receiver which is electronically tuned or swept in frequency at a very high rate. Electronic tuning eliminates the single octave tuning limitation inherent in mechanical tuners. The panoramic frequency display presents the signal environment for a warning capability equivalent to that of a wide band receiver. For signal analysis, the sweep may be

stopped to provide the normal narrow band receiver audio and video outputs.

(C) An important capability of the rapid scanning receiver is realized in its use as a threat signal warning receiver where only the portion of the frequency spectrum that contains a known threat emitter is swept. The output of this receiver normally is applied to both audio and video alarm systems.

4.2.2.2 (C) Wide Band Receivers. Wide band or direct detection receivers simultaneously intercept all signals within the full range of the receiver frequency coverage and within the intercept limits of their intercept antenna. The use of channelized crystal video receivers will permit higher sensitivities to be obtained and will permit detection to be defined to more specific areas in the band. A different version of the wide-open receiver that is proving to be quite valuable is the Instantaneous Frequency Measuring (IFM) receiver system. This system not only provides both wide and narrow band reception capabilities, but permits instantaneous read-out and storage of the frequency parameters. These receivers can provide an audio or video warning of signal activity within their frequency range.

(C) Wide band receivers have a high signal detection probability over a broad portion of the spectrum. They frequently are used in conjunction with narrow band receivers to provide increased signal detection probability over a broad frequency range while the narrow band receiver provides effective signal analysis. Other advantages of this type of receiver include simplicity, light weight, and compactness.

(C) Wide-open receivers are relatively ineffective in environments with a high signal density since they have a poor signal discrimination capability. Care must be exercised in the operation of wide-open receivers in the presence of high intensity radiations. If they are not blanked during own ship's high-powered emissions, they are susceptible to receiver overloading and consequent crystal failure.

4.2.2.3 (C) Hybrid Receiver. A hybrid receiver is one in which both wide band and narrow band capabilities are incorporated, thus retaining the capabilities of both types and overcoming the limitations inherent in each. A hybrid system may be either a basic crystal video system with crystal video channel(s) or a superheterodyne system, or both. The presence of the crystal video section improves probability of detection; the superheterodyne portion improves analysis capability, particularly frequency determination.

4.2.2.4 (C) IFM Receiver. An IFM receiver is a wide band receiver capable of measuring frequency instantaneously on a pulse by pulse basis. A basic IFM receiver consists of a frequency discriminator, detectors, video amplifiers, processor, and a display. IFM receivers provide 100% probability of the intercept with good frequency resolution and accuracy. Principal use of an IFM receiver is for automatic spectrum surveillance in an ESM system. A common display used with an IFM system is a calibrated polar display in which frequency is indicated by polar position of the strobe(s) and relative signal strength (signal amplitude) is indicated by strobe length. Storage tubes which have long persistency are frequently used with IFM receivers to give the operator sufficient time to read short duration signals which might appear in the same band.

4.2.2.5 (C) Microsweep Receiver. A microsweep receiver is a basic superheterodyne receiver utilizing a very fast sweeping local oscillator capable of sweeping an octave in one microsecond. The probability of detection is significantly better than that of a slower superheterodyne receiver and is achieved by the faster sweep rate. Incorporation of dispersive filters and pulse stretching by means of a recirculating delay line loop enhance the probability of detecting incoming pulses. A panoramic display of spectrum signal activity is a commonly used display.

4.2.3 (C) Displays

Displays are provided with ESM equipment to:

1. Alert the operator to a signal

2. Present a view of the intercepted frequency spectrum

3. Provide for analysis of intercepted signals

4. Determine the bearing of the source of an intercepted signal

5. Provide tasking instructions and target signal data.

4.2.3.2 (C) Panoramic Displays indicate signal frequency versus amplitude, usually in X Y coordinated, but they can use polar coordinate form as in displays for IFM systems.

(C) The panoramic display permits visual observation of the intercepted portion of the frequency spectrum. In the case of a wide band or swept receiver system, the scale permits simultaneous observation of signals throughout the full frequency range of the receiver. A narrow band receiver system panoramic frequency display presents only the signals within the acceptance band of the receiver. In this case, the display is calibrated to indicate frequencies above and below the tuned frequency of the receiver. The modulation of the intercepted signal will provide on the panoramic display unique variations in amplitude and/or pulse position, depending on the type of modulation, providing the operator an opportunity to determine quickly another fingerprint of the intercepted emission.

4.2.3.3 (C) Pulse Analyzers provide a display permitting electronic analysis of the intercepted signal. These units determine:

1. Pulse repetition frequency (PRF)

2. Pulse shape and width

3. Scan characteristics.

Pulse analyzers use a multigun oscilloscope display to present the intercepted pulse on several traces with different time basis. The shorter time base traces are used to expand the pulse as much as possible to permit accurate shape and width determination. The longer time base traces are used to present more than one pulse within a trace, permitting accurate determination of PRF.

4.2.3.4 (C) Audio Displays of the ESM system also provide tactical information to the operator. The antenna rotation rate, or scan rate in the case of sector operation, of the target emitter is determined by timing the periods between energy bursts as heard in the headset. Horizontal beam width can be estimated by taking the ratio of lobe duration to antenna rotation rate. Any amplitude variation of the pulse train will produce a deviation from the tone presented by the basic PRF of the signal. Certain types of scans produce a unique repetitive variation in the tone, providing the operator with the most accurate means of scan identification.

4.2.4 (C) Receiving Antennas

4.2.4.1 (C) Location of Antennas. For optimum performance, shipboard receiving antennas must be located as high as possible and kept away from objects which can shadow, reflect, or radiate electromagnetic energy. Aircraft antennas must be located to minimize the effect of aircraft structure on antenna patterns. Protective covers and radomes must be kept clean and free of substances like metallic paints which

reflect and attenuate electromagnetic energy. Antenna lead-ins should be as short as possible, particularly at microwave frequencies, and kept away from power cables or other sources of interference. Suitable grounding of metallic structures in the vicinity of high-powered radiators is necessary to prevent arcing and the resultant generation of wide band electromagnetic interference (EMI). Antennas may be used singly or in arrays to produce the desired patterns, which are usually classified as omnidirectional or directional.

4.2.4.2 (C) Omnidirectional Antennas have low gain and patterns which permit reception over very wide azimuth and elevation angles. They permit wide angle surveillance and increase the probability of intercept of ESM systems at the sacrifice of overall system sensitivity and an ability to discriminate against signals from a particular direction.

4.2.4.3 (C) Directional Antennas may be used singly or in arrays. They have higher gain than omnidirectional antennas and have much narrower patterns. They may be used in arrays to determine direction of the signal source by comparison of phase or amplitude of the same signal as received by different antennas in the array. Directional antennas increase the sensitivity of ESM systems at a sacrifice in intercept probability if the receiving angles are restricted. They are useful for discriminating against signals not coming from directions covered by the pattern. Single directional antennas may be capable of being positioned in a given direction for high gain, or of being rotated in the azimuth plane. Rotating at speeds of 300 to 2000 rpm, when used with a suitable receiver and display which shows signal amplitude vs azimuth, they may be used for direction finding after calibration as a function of azimuth and frequency.

4.2.5 (C) Recorders. Magnetic tape recorders are used to provide a magnetic record of a received signal which can be later subjected to a detailed analysis. Tape recorders may be either analog or digital, single channel or multichannel. Analog recorders may be connected to a receiver-audio output, or if they have wide enough bandwidth, to a receiver-video or IF output. Digital recorders must interface with a computer or other electronic equipment which produces a formatted digitized output. Digital recorders are often run on an incremental or start-stop basis. Analog recorders are often run continuously, as their start-up time may be long enough to preclude recording of a short-duration signal.

(C) The most important characteristics of an analog recorder are the number of channels and the acceptance bandwidth per channel. Recorders having wide acceptance bandwidths usually operate at high tape speeds and use up tape at a rapid rate. While recorders with wide acceptance bandwidths and wide dynamic ranges are available, receiver outputs may exceed both frequency and dynamic range limits of the recorder, and signal conditioners may be required between the receiver and the recorder. Recordings requiring very accurate frequency analysis may utilize a fixed frequency signal in one track on the recorder for compensation of variations in tape speed during playback. Analog recorders using direct recording techniques have a lower limit on the frequency range which is recorded. An FM or other carrier system may be used if very low frequency response is required. Retrieval of data from analog tapes is often done manually, using filters, oscilloscopes and other signal-analysis equipment. Readout of digital tapes is always by machine, usually another computer.

4.2.6 (C) Cameras. Photographs should be taken of unusual or unique signals presented on the analyzer scope and of radar jamming, interference, or deception presented on the radar and analyzer scopes.

(C) The Polaroid (CR-9 Model) EYE MO (movie camera), or KS-63A camera or equivalent, should be used for ESM analyzer scope photography.

(C) The Polaroid, CRZ-6 or CR-1A camera or equivalent, should be employed for radarscope photography. The Polaroid camera has the advantage of providing a print for immediate evaluation as well as for laboratory analysis.

(C) The Polaroid CR-9 oscilloscope camera is specifically designed for oscilloscope spectrum analysis. No hood need be mounted on the AN/WLR-1 scope for use with the camera since the CR-9 features an attachable hood compatible with the scope as well as a trigger handle for ease of operation.

(C) In the event a camera is not available, a carefully prepared sketch of the pulse analyzer, panoramic, or radar repeater presentation, accompanied by a verbal description of signal behavior, can be beneficial to the analyst.

4.3 (C) PLANNING REQUIREMENTS

(C) It is essential that naval personnel who are responsible for planning ESM operations have an understanding of:

1. Mission of own force

2. Enemy threat to assigned mission

3. Own intercept equipment capabilities and status

4. Tactical communications, radar surveillance, and weapons systems requirements

5. Force/group disposition

6. SIGINT requirements

7. The effect of interference from electromagnetic equipment.

4.3.1 (C) Probability of Intercept. The probability that an ESM system can detect and process a received signal depends upon the following:

1. Duration and strength of the signal at the receiving antenna

2. Modulation of the signal

3. Frequency of the signal

4. Directional characteristics of the receiver antenna system

5. Sensitivity of the receiver

6. Bandwidth and scan rate of receivers

7. Distance between intercept platform and transmitting site

8. Beam pattern and scan characteristics of the emitters.

4.3.2 (C) Conducting ESM Operations

4.3.2.1 (C) Intercept Assignments are based on the capabilities and characteristics of available intercept equipment and the requirements for continuous surveillance within designated frequency limits. Assignments of intercept search are detailed in paragraph 4.5.

4.3.2.1.1 (C) Guardship Responsibilities. Guardship assignments indicate intercept search responsibility of participants for specified frequency bands. Operators responsible for carrying out the assignments must have detailed knowledge of the following:

1. Intercept responsibilities

2. Factors affecting equipment operations

3. Equipment status

4. Intercept system characteristics and capabilities.

4.3.2.1.2 (C) Intercept Considerations. Rapidly scanning the assigned frequency band greatly increases the probability of detection. By narrowing the frequency band guarded, it is possible to increase the rapidity of the search, thereby increasing the probability of detection. Assignment of intercept guards should be based on:

1. Type of intercept equipment

2. Threat (enemy EOB)

3. Type and class of platform (aircraft, ship, submarine)

4. Type of DF system

5. ECM assignment

6. Radar guardship assignment

7. Position in force and mission assigned

8. Type of weapon system (for example, antiradiation missile capability).

4.3.2.1.3 (C) Operators should be able to search effectively and repeatedly the assigned band to achieve the best intercept probability. Intercept probability is affected by:

1. Intercept system available

2. Types of receiver tuning to be used

3. Watch duration

4. Operator proficiency (influenced by both training and experience).

4.3.2.2 (C) Intercept Range. The distance at which a transmitter can be detected is related to many factors, such as frequency, antenna height, effective radiated power (ERP), antenna gain or directivity of both receiver and transmitter minor lobing, scatter

propagation, diffraction, as well as receiver intercept sensitivity. In most cases, the intercepting platform has the advantage over a platform searching with radar. Figure 4-2 is included to assist in the calculation of range in various height at the antenna. Assuming an emitter and an ESM system within line of sight of each other, the principal determiners are emitter ERP, receiver system sensitivity and propagation. The nomograph in Figure 4-3 is usable for derivation of this range.

4.4 (C) GENERAL SEARCH TECHNIQUES

4.4.1 (C) Detecting Signals by Means of Intercept Receivers. In addition to meeting sensitivity and selectivity requirements, search receivers must also meet requirements of image rejection and tuning techniques appropriate to search applications. Because of interference from various sources, false signals often will appear. The most common false signals are:

1. Image Response — An undesired carrier frequency that differs from the frequency to which a superheterodyne receiver is tuned by twice the intermediate frequency.

2. Spurious Signals — Undesired signals generated in the receiver from the mixing of intercepted signals with harmonics of the local oscillator.

3. Others — The harmonic and heterodyne products generated as the result of nonlinear mixer characteristics when strong signals are impressed on the receiver.

(C) Search receivers are normally of the superheterodyne type and may be tuned either automatically or manually. Automatically tuned receivers sweep through a band of frequencies a number of times every second. A manually tuned receiver covering approximately the same frequency range will have a much lower probability of intercept but permits the operator to tune to a single intercepted signal for analysis.

4.4.2 (C) Appearance of Signals in the Panoramic Display. By using a combination receiver and panoramic display or adapter, the operator can see all signals receivable within a band of frequencies determined by the bandpass of the receiver. The panoramic display is usually a cathode-ray tube with frequency shown as a horizontal line and signals shown as vertical lines. Amplitude of the signal is directly proportional to the length of the line. The mid-position of the panoramic scope represents the center frequency of the receiver IF bandwidth and is indicated on the receiver dial calibration as signal frequency. When used in intercept of electromagnetic radiations, it allows the operator to visualize the electromagnetic spectrum on a two-dimensional surface, indicating both frequency and signal amplitude. The character of the signal and the type of modulation (whether amplitude, frequency, or pulse), as well as the nature of the interference, are revealed. The panoramic display may also assist the operator in discovering the enemy's employment of ECCM techniques. With the advance of technology, intercept tasks become increasingly difficult. To minimize detection probability and avoid countermeasures action, advanced systems are frequently programmed to vary parameters during the transmission interval. Changes in frequency, pulse repetition rate, and pulse width magnify intercept and identification problems. Signals commonly intercepted and their appearance on the panoramic adapter are shown in NAVPERS 92440 and operators sections of equipment technical manuals.

(C) Because of the sweeping nature of a normal panoramic system, two problems are commonly encountered. The sweep speeds affect the probability of detection and must be optimized for different pulse emitters. The pulse spectrum, commonly known as the SIN X/X characteristic, causes the strong pulsed signals to spread out and cover the weaker signals. The IFM frequency display does not suffer from this problem; it provides an excellent device on which to observe unusual frequency parameter activity.

4.4.3 (C) Using Antennas to Determine Bearing of Transmission. It is necessary to integrate an efficient antenna into the overall intercept search system. The design, location, and connections between antenna and receiver affect the efficiency of the antenna

HEIGHT OF TRANSMITTING ANTENNA (IN FEET)	0	25	50	100	150	500	1000	5000	10,000	20,000	30,000	40,000	50,000
50,000	274	280	283	286	289	302	313	361	397	449	489	520	548
40,000	246	252	255	258	261	274	285	333	369	421	461	492	520
30,000	215	221	224	227	230	243	254	302	338	390	430	461	489
20,000	175	181	184	187	190	203	214	262	298	350	390	421	449
10,000	123	129	132	135	138	151	162	210	246	298	338	369	397
5,000	87	93	96	99	102	115	126	174	210	262	302	333	361
1,000	39	45	48	51	54	67	78	126	162	214	254	285	313
500	28	34	37	40	43	56	67	115	151	203	243	274	302
150	15	21	24	27	30	43	54	102	138	190	230	261	289
100	12	18	21	24	27	40	51	99	135	187	227	258	286
50	9	15	18	21	24	37	48	96	132	184	224	255	283
25	6	12	15	18	21	34	45	93	129	181	221	252	280
0	0	6	9	12	15	28	39	87	123	175	215	246	274

HEIGHT OF RECEIVING ANTENNA (IN FEET)

NOTES:

1. The table provides values of the radio horizon range for varying heights transmitting and receiving antennas.
2. To obtain the radio horizon range proceed along the line corresponding to the transmitting antenna height to the column corresponding to the receiving antenna height. The figure in this square is the R.H.R. in nautical miles.
3. Interpolation should be used to obtain intermediate figures.
4. The radio horizon range can also be estimated from this formula:

$$R=1.23x(\sqrt{h}+\sqrt{H})$$

Where R is the range in nautical miles, and h and H are the height in feet of the transmitting and receiving antennas above the earth's surface.

Figure 4-2. (C) Radio Horizon Range (in Nautical Miles)

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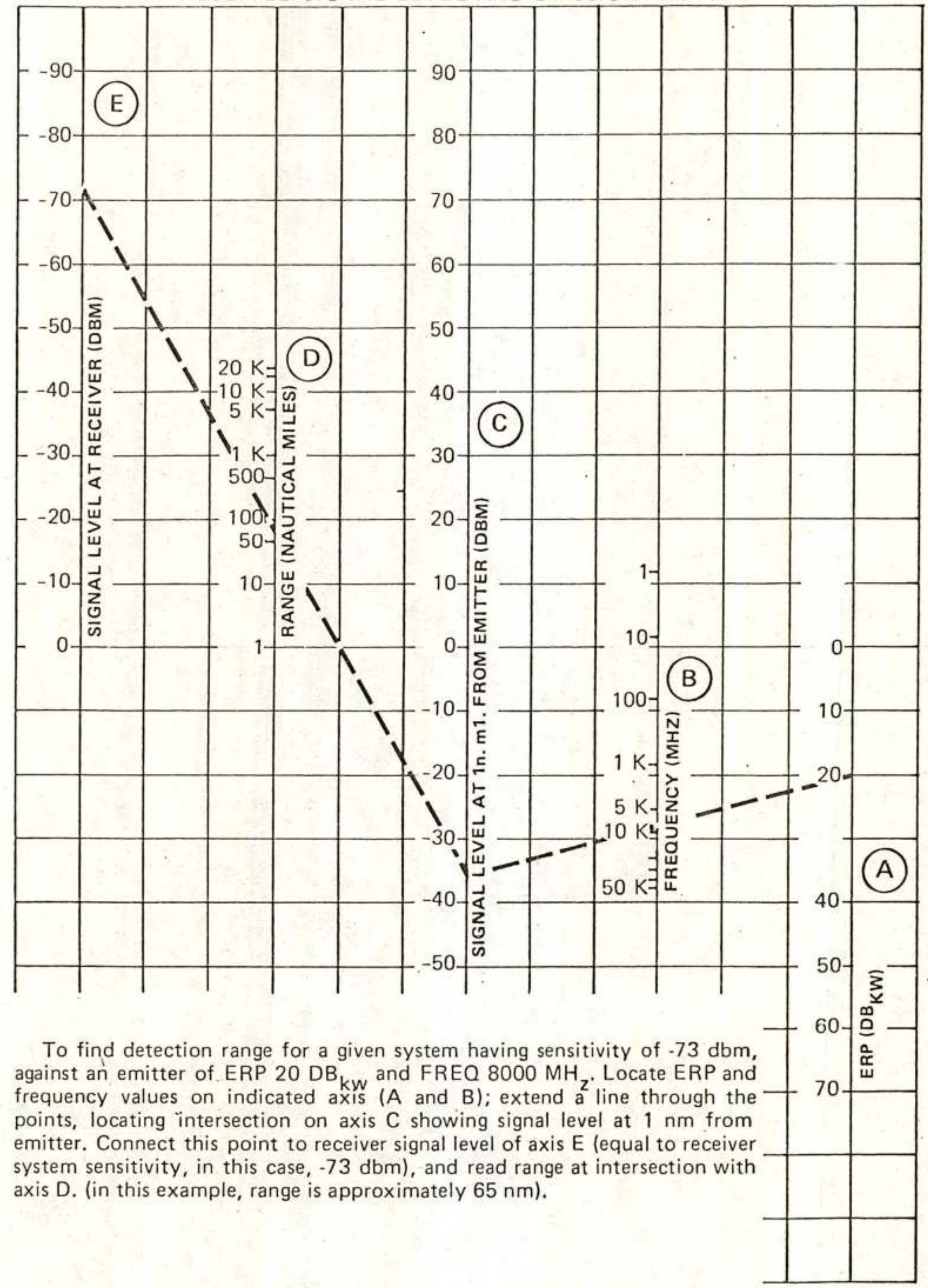
NOMOGRAPH RELATING PROPAGATION RANGE, RECEIVED SIGNAL LEVEL AND EMISSION FACTORS



To find detection range for a given system having sensitivity of -73 dbm, against an emitter of ERP 20 DB$_{kw}$ and FREQ 8000 MH$_z$. Locate ERP and frequency values on indicated axis (A and B); extend a line through the points, locating intersection on axis C showing signal level at 1 nm from emitter. Connect this point to receiver signal level of axis E (equal to receiver system sensitivity, in this case, -73 dbm), and read range at intersection with axis D. (in this example, range is approximately 65 nm).

Figure 4-3. (C) Nomograph for Deriving Intercept Range

system and the overall performance of the search equipment.

(C) Factors which tend to alter this relationship are minimized by careful design of receiving antenna equipment. Location of the enemy emitter is of extreme tactical importance. The bearing of the emitter is determined by finding the direction of arrival of the intercepted signal. However, this directional indication will generally be in error, requiring application of calibration curves (determined for each antenna installation and each frequency band) to obtain the actual bearing of the intercepted signal. The basic units necessary for direction finding are:

1. A highly directional receiving antenna

2. A sensitive receiver

3. A suitable indicating device.

(C) Intercept bearing may be determined by rotating a directional antenna to a signal null or a position of highest signal amplitude. It may also be determined by using two or more antennas in an array and measuring amplitude or phase differences between the signals received by different antennas.

4.4.4 (C) Intercept Search Operations

4.4.4.1 (C) Search and Detection are accomplished by searching the usable portion of the electromagnetic spectrum, particularly those frequencies suspected of being used by the enemy for radar detection and tracking, communications, navigation, IFF, or missile control. This stage of intercept search supplements radar or visual observation. However, it normally is used without radar when surprise or evasion is a primary consideration. Warning of enemy activity may be obtained earlier by ESM than by any other sensor.

4.4.4.2 (C) Location and Tracking. All electromagnetic transmissions are susceptible to DF techniques. Bearings taken on an intercepted signal permit establishing the location and tracking of the emitter by navigation plots. If the tactical situation permits, an individual ship may be able to obtain a rapid location of the enemy emitter by use of the method whereby the ship is allowed to take a few sweeps with its radar to obtain the location of the source of the intercepted signals.

(C) If the EMCON condition in effect precludes the use of radar or other active sensors to assist in locating and tracking a passive intercept platform, the Single Ship Passive Ranging Technique (Bearings Only) may be utilized. This method is slow and accuracy depends on many variables; however it may be the only means available to fix the position of and track an intercepted signal platform. An example of a Bearings Only problem with a polar coordinate plot illustration is contained in Appendix D.

(C) Simultaneous DF bearings from two or more ships located with bearing separation from the target emitter will also provide a rapid means of emitter location.

4.4.4.3 (C) Signal Analysis furnishes data on the technical characteristics of enemy electronic weapons and devices. Certain signal characteristics are read directly from the intercept system displays. Tactical information gained by signal analysis provides a basis for:

1. Threat signal recognition

2. Use of ECM

3. Attack reaction

4. Tactical evasion

5. Employment of other defensive capabilities

6. Specific emitter fingerprinting.

It further provides material for detailed intelligence study by research and development agencies. Signal analysis is performed in tactical situations as follows.

4.4.4.3.1 (C) Enemy or Unidentified Signals. Rapid signal analysis is mandatory. Identification, evaluation, and required ECM are immediate considerations. After satisfying these considerations, further data are recorded on reports and logs.

4.4.4.3.2 (C) Electronic Reconnaissance of Enemy Installations. Intercept search is planned and deliberately conducted to obtain complete data on signal characteristics of enemy installations. These data are inputs to the enemy EOB and are used for planning future combat operations.

4.4.4.4 (C) Signal Evaluation. Data obtained in the first three steps of intercept may indicate:

1. Degree of threat

2. Position of the enemy

3. Course and speed of emitting unit

4. Force composition

5. Type and quality of enemy electronic equipment

6. Identification of threat platform.

Accurate information and evaluation of enemy transmissions are aided by a knowledge of known enemy emitter parameters.

4.4.4.5 (C) Collation of ESM Information. For fine grain analysis of ESM data by trained analysts, the relationship of signals occurring in the same interval may reveal the purpose or capability of systems using several emitters. For this type of analysis, it is imperative that intercept procedures provide for the correlating of all emissions on a common time basis.

(C) Where intercepts are recorded on magnetic tape, a time code generator provides a convenient and accurate means of establishing time at which an intercept was recorded.

4.4.5 (C) Intercept Search by Type of Unit

4.4.5.1 (C) Surface Ships. Intercept search used by a group of ships is best conducted by a picket or screen ship on the perimeters of the force. This employment:

1. Ensures earliest possible detection

2. Reduces radiation interference from centrally located ships

3. Provides more accurate DF cross bearings.

The value of intercept search by surface ships is primarily that of providing warning of an enemy's presence prior to or in lieu of its detection by radar. The fact that intercept search can also be used as a valuable tool in identification should not be overlooked.

(C) Surface ships can conduct reconnaissance sweeps in a manner similar to aircraft. High speed should be employed during the sweep to optimize the DF bearing spread. Ships have the advantage of superior navigation accuracy, minimizing emitter site location errors. However, ships are relatively vulnerable and their low antenna height causes many emitter sites to be screened. Bistatic radar-equipped pickets can be deployed in proximity to enemy coasts to locate coastal early warning radars and detect surface search radar-equipped craft ashore.

(C) ESM must be used at all times when the normal CIC watch is established, and maximum tactical use of intercept equipment must be made. For effective intercept, the same ship ordinarily should not be assigned both radar and intercept guard duties at the same time. NTDS units can fix target location more rapidly by the exchange of individual ship bearing lines via Link 11 (computer to computer). Subsequent fixes will be displayed on NTDS consoles.

4.4.5.2.1 **(C) Tracking Procedure.** The problem of locating an electromagnetic signal source is primarily one of using homing techniques or plotting DF bearings. The usual procedure is to close the signal source until the signal is strong enough to provide a good indication of its direction. Once the bearing has been obtained the aircraft course is altered to:

1. Obtain a more rapid change of bearing

2. Obtain a greater spread in bearing lines

3. Cause bearings to fall within sectors not affected by aircraft shadow areas.

4.4.5.3 **(C) Submarines** are well adapted for gathering tactical and strategic information on enemy electronic activities. As pickets for a surface task force, submarines can be assigned to conduct intercept search and other electronic operations.

4.4.8 **(C) Penetration Aid (PENAID)** is a tactic used by aircraft or surface units to obtain an indication of the detection capability of a radar. A subsequent use of this information could assist in tactical evasion. This is done by using an analyzer to observe the "clutter" present at the trailing edge of the radar pulse. As the range between detecting platform and emitter decreases, the "clutter" at the trailing edge of the pulse increases.

(C) When no "clutter" exists on the trailing edge of the received pulse (Figure 4-4), the ESM platform is outside the radar detection envelope. With "clutter"

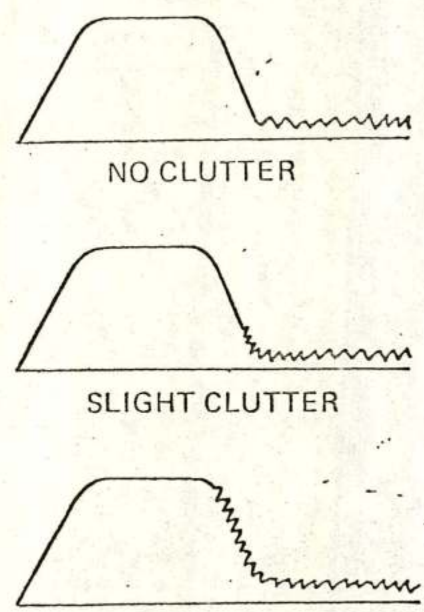


Figure 4-4. (C) PENAID Clutter Analysis

barely discernible, the ESM platform is at the radar detection threshold. A distorted trailing edge indicates that the intercept platform is well within the radar detection envelope of the victim radar. Aircraft employ this tactic to penetrate a radar defense as far in as possible without being detected. This is accomplished by adjusting altitude to remain below the search radar main lobes. The PENAID technique provides the ESM operator with information necessary for the aircraft to carry out such maneuvers. The factors affecting "clutter" noted by the ESM operator will not necessarily be consistent over a given period of time. Variations in the degree of "clutter" may result from changes in propagation conditions, victim radar power, and own receiver sensitivity. Irregular lobe patterns or a multiple radar environment can additionally complicate an ESM penetration. In view of the above, caution and operator experience must be employed to successfully apply this tactic.

4.5 (C) INTERCEPT GUARDS AND ASSIGNMENT

(C) In assigning intercept search guards, the following should be considered:

1. Intelligence estimate of expected enemy emissions in the particular geographic area

2. Determination of enemy emissions which constitute a threat to the force

3. Capabilities and limitations of own equipment

4. Position of the particular units within the force

5. Other tasks assigned to the unit

6. Review of guard assignments when any of the above change

7. Guards are assigned using frequency indicators from Appendix C.

(C) ESM RECONNAISSANCE

(C) ESM reconnaissance may be conducted by any unit having an intercept capability. This reconnaissance is performed to satisfy immediate tactical requirements as well as longer range strategic requirements. The purpose of ESM reconnaissance is to determine:

1. Quantity and types of enemy-operated equipment

2. Electronic equipment use

3. Location of enemy electronic equipment

4. Value the enemy is deriving from use of his electronic equipment

5. Possible threat to friendly forces from the enemy's use of electronic equipment

6. Characteristics and capabilities of enemy electronic equipment to establish and associate specific emitter "fingerprints."

4.6.1 (C) Ship Reconnaissance. Plans for the coordination of radar/radio and ESM equipment must be formed and followed to ensure the most effective use of each. The following points should be considered.

1. To minimize detection by the enemy and to prevent interference with own ESM operations, only intermittent radar/radio operations should be authorized.

2. During heavy weather and in the vicinity of land masses, ESM search coordinated with radar search may be particularly valuable. The effectiveness of airborne early warning radar may be limited or may not be available.

3. Minimum radar scanning and radio transmitting should be conducted. Stopping the radar beam on target or continuously transmitting on radio circuits makes it easy for an enemy intercept operator to locate and to determine the characteristics of the radar/radio and permits him to adjust his jamming equipment more effectively.

4. The time between radar operating periods depends largely on the sweep width of the radar in use and the necessity to use the equipment for search, tracking, and navigation. Similarly, the need to use radio transmissions must be weighed against the resultant opportunity offered to the enemy for intercept and DF of those transmissions.

4.6.2 (C) Aircraft Reconnaissance. For a reconnaissance aircraft to be effective, it must remain on station long enough to permit required ESM intercept functions to be performed. The most important factor here is the altitude of the search aircraft. Under most circumstances it is expected that the intercept can be accomplished before the radar detects the search unit.

4.6.2.1 (C) Electronic Reconnaissance from Aircraft takes on many forms, such as the following.

4.6.2.1.1 (C) Standard Electronic Order of Battle (EOB) Missions. These missions are usually flown on approved tracks with the prime objective of updating data on known emitters, locating new emitters, analyzing the situation, and projecting future trends. The tactical evaluator on the aircraft receives all ESM information from the operators, analyzes it, and directs the operator's primary areas of search. New and unusual signals are analyzed and recorded for postmission analysis. Specific emitters that can be identified are fingerprinted and compared to previous records.

4.6.2.1.2 (C) Stand-off Warnings. Normally associated with carrier strike support missions, the primary purpose of these missions is to provide warnings to strike aircraft on such things as missile launches, enemy aircraft alerts, and unusual activity in certain areas.

4.6.2.1.3 (C) Special Collection Efforts. These missions are directed against specific systems or against all associated emitters in a specific situation. This type of information is necessary to determine how a complete system, such as a complex missile system, will be used in a tactical situation. ECM equipment is often developed as a result of this type of collection effort.

4.6.2.1.4 (C) Specific Emitter Identification. These missions are used to associate specific emitters on new types of emitters to specific locations or ships. These involve flying in on the signal bearing and associating the emitter to both the ship and a specific antenna when possible. The emitter is also fingerprinted when possible, and this fingerprint associated with the hull number on the ship. Photographs are taken when conditions permit.

4.6.2.1.5 (C) Fleet Exercises. Aircraft work with the fleet on fleet readiness exercises, NATO exercises, EMCON checks, and so forth. The airborne reconnaissance aircraft will often evaluate the fleet from the enemy and friendly standpoint and make recommendations for improved fleet electronic operations.

4.6.2.1.6 (C) Overflight Warning and Intercept Missions. The reconnaissance aircraft will stand off from the concerned ship or ships and make passive detection of incoming aircraft. In many cases, a fighter aircraft will accompany the reconnaissance aircraft and make the intercept.

4.6.2.2 (C) Visual and Photographic Contact Procedures. If visual or photographic contact must be made with the unit using radar, it is desirable for the ESM aircraft to fly at a lower altitude. This will delay but will not prevent radar detection. Consideration should be given to such facts as the enemy's:

1. Radar equipment location
2. Radar shadows
3. Blind spots
4. Beam lobes
5. Range limitations.

4.6.2.3 (C) Recognition, Utilization and Classification. It is highly desirable for the ESM operator to recognize and classify the enemy radar in real time. The pattern for further reconnaissance and aircraft survivability tactics will be influenced by the ESM crew's evaluation of the types of radar detected. Other associated emissions must be searched for and evaluated to provide an overall assessment of the tactical significance of the use of the electromagnetic spectrum. An illustrative response to an ESM contact follows.

(C) When an ESM contact is gained:

1. The ESM operator notifies the aircraft commander that he has detected a radar. The aircraft radar is put in standby. This contact information may be passed on to friendly units in the area if the tactical situation and conditions of EMCON permit.

2. The pilot commences a let-down to get under the enemy radar lobes. The altitude at which contact is lost indicates the approximate range of the radar. Once under this lobe, the pilot increases altitude until the ESM operator is just able to identify the radar signal, at which point the aircraft should be on the lower edge of the radar lobe but not detected by the enemy radar.

3. The bearing of the contact is obtained as soon as possible and, if the tactical situation permits, the position of the radar is obtained by means of a series of bearings. From these bearings it can be determined whether the radar is ashore or being carried in a ship or aircraft.

4. The characteristics of the radar and whether it is operated by friendly or enemy forces are determined. A complete and accurate log is kept on all contacts. In addition, the ESM operator obtains permanent recordings and photographs of the intercept if facilities are available.

5. If the ESM operator evaluates the contact as a ship and tactical conditions and instructions permit, the aircraft homes on the contact, gradually decreasing altitude in order to remain just below the lower edge of the radar lobes.

6. The aircraft, now having approached within the probable detection range of the enemy radar, turns on its radar to determine the range and composition of the contact.

7. If flying over the emitter, photographs should be taken of the contact in order to correlate physical and electronic characteristics of the emitter.

4.6.3 (C) Submarine Reconnaissance. Submarines are ideally suited to conduct covert ESM reconnaissance missions of enemy coastal areas. The submarine's inherent ability to remain undetected greatly enhances the collection of valuable information concerning electromagnetic radiations from unalerted enemy forces. This, coupled with precise navigation equipment and excellent on-station endurance, provides a capability for covert collection that cannot be found, to the same degree, in either surface ships or aircraft.

4.6.4 (C) Briefing Instructions and Search Assignments. To ensure adequate ESM surveillance and prevent needless duplication of effort, specific frequency guard assignments must be made. In addition to trying to detect the presence of known radars, the plan should provide for searching for indications of newly deployed equipment. Briefings should include discussion of tuning units required for the types of radar which will probably be encountered on the mission. In particular, the emitter locations and characteristics should be reviewed. Friendly electronic equipment that will be radiating should be reviewed to reduce the operator's confusion.

(C) Crews must be debriefed as soon as possible after all ESM missions. ESM logs, tapes, and films should be examined to find the EOB. Essential information required by the appropriate commander will be extracted from these data and forwarded immediately.

4.7 (C) MISSILE/RADAR HOMING AND WARNING RECEIVERS

(C) Typically a missile/radar homing and warning system consists of a wide-band crystal video receiver designed to intercept, identify, and display the direction to those emitters illuminating the receiving platform. It attempts to identify the type of enemy radiations, restrict the display to signals associated with enemy threat systems, code the display as an aid to identification, and provide aural alerting to the operator.

4.7.1 (C) Tactical Aircraft are configured with a radar warning receiver capability and a missile launch/alert device.

(C) The radar warning receiver provides for detection and direction finding of virtually all SAM target-tracking radars, AI radars, and AAA fire control radars, and also provides for detection and DF of naval SAM systems missile guidance signals which are within its frequency coverage.

(C) The missile launch/alert receiver detects SAM missile guidance signals, providing the pilot with missile launch and missile alert information.

4.7.2 (C) The LAMPS Helicopter, SH-2D, and the ASW Helicopter SH-3H, are configured with a single receiver (ALR-54) to accomplish both missions of radar homing/warning and missile warning. The system is designed to alert the aircrew of enemy ASCM threats or associated launch platform emitters.

4.8 (C) ANALYSIS AND EVALUATION

(C) A detected radar signal must be analyzed and compared with the characteristics of known equipment to determine whether it is a friendly or enemy transmission.

4.8.1 (C) Radar Characteristics. Each radar possesses certain characteristics or a combination of characteristics peculiar to its purpose. Evaluation of signals is based on the following.

4.8.1.1 (C) Modulation. A continuous wave (CW) transmission has essentially no modulation. If the wave is interrupted (ICW), if its amplitude (AM) or frequency (FM) is varied, or if it is pulsed (PM), it is considered to be modulated and is analyzed accordingly. Most radars presently in use are pulse modulated and, consequently, have a pulse repetition rate and pulse width. The type of modulation can be determined from the system displays. Modulated transmissions are shown in Figure 4-7.

4.8.1.2 (C) Pulse Repetition Frequency (PRF) is the rate at which pulses are transmitted from a radar set and is measured in pulses per second (PPS). For radars which use a constant PRF, the maximum unambiguous range is limited by the interval between two consecutive pulses and can be determined using the formula:

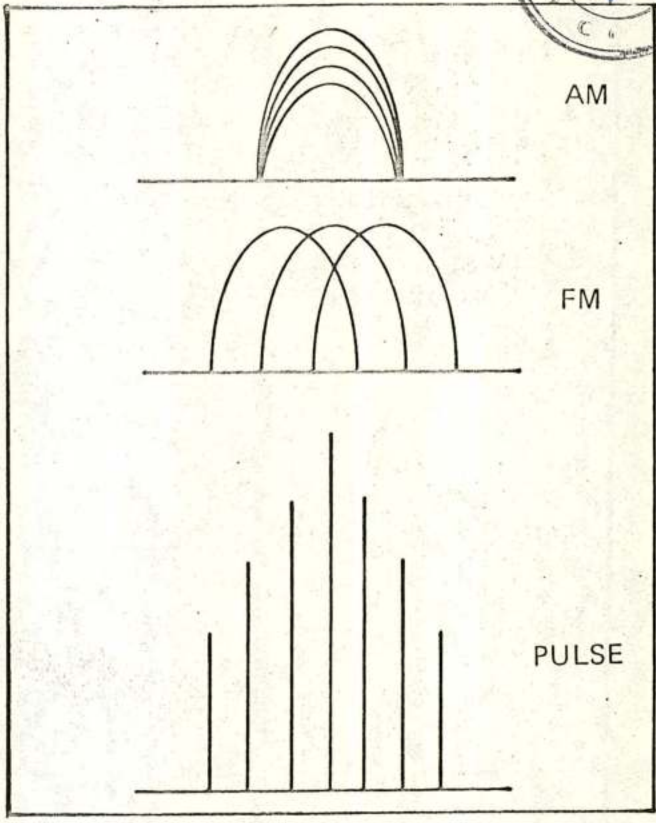


Figure 4-7. (C) Types of Modulation

Pulse Repetition Frequency		Probable Range Capability
Low:	Under 350	Long range
Medium:	350 to 1,000	Medium range
High:	Over 1,000	Short range

Figure 4-8. (C) PRF and Probable Range Capability

"pulse stagger," a technique in which more than one pulse repetition interval (PRI) occurs in a sequential pattern. The theoretical maximum unambiguous range in this case is determined by the longest PRI utilized. Theoretical maximum range is the unambiguous range capability of a radar system and does not reflect the maximum effective range capability of the system.

(C) As PRF increases, the theoretical maximum range decreases. Figure 4-8 relates PRF to probable range capability.

(C) Some radars employ more sophisticated modulation techniques in which multiple PRFs are employed. The most common of these modulations is

4.8.1.3 (C) PRI is the measurement of the time interval from the start of one pulse to the start of the next pulse. PRI is the mathematical reciprocal of PRF and can be measured through the use of a calibrated oscilloscope or numerous other state-of-the-art automated measurement/analysis devices. Determination of accurate PRI/PRF measurements has considerable tactical value by utilization of radar "fingerprinting" techniques. Radar fingerprinting (or "electronic signature") is the technique of identification of a specific emitter based upon unique parameter(s) and association of the emission with a platform or location. Although PRF/PRI is the principal parameter involved in radar fingerprinting, other parameters such as scan periods/rates, and radio frequency (RF) can fingerprint a few emitters. The unique identification of a radar emitter by fingerprinting provides valuable intelligence which may be utilized several ways. The principal applications are the compilation and updating of radar order of battle information and tactical weapons targeting. The most rewarding application of radar fingerprinting is the ability of the ESM collector to effectively use unique radar fingerprints to identify and track contacts in order to jam victim radar systems without the assistance of visual or radar contacts.

4.8.1.4 (C) Pulse Width (PW) is the time a radar transmitter is energized during each pulse, measured in microseconds. Theoretical minimum range and the degree of resolution (ability to discriminate between targets on the same bearing) at that range are determined by the pulse width. PW also affects maximum range. A wider pulse has more average power and thus increases the maximum range of detection, while a narrower pulse offers higher resolution at the expense of decreased detection ranges.

(C) Weapons control radars usually have a very narrow pulse width to obtain good resolution and short minimum ranges. Figure 4-9 relates PW to the probable range capability of a search radar.

Pulse Width (usec)		Probable Range Capability
Narrow:	Under 1	Short range
Medium:	1 to 4	Medium range
Wide:	Over 4	Long range

Figure 4-9. (C) PW and Probable Range Capability

(C) In some radars, the use of certain techiques such as "pulse compression" permits high resolution with a pulse width which appears to be much greater than that which would be expected.

4.8.1.5 (C) Frequency is the number of complete cycles per second of a wave motion and is inversely related to wavelength. Wavelength is the distance in space traveled by a wave during one cycle of its frequency.

(C) Frequency directly affects the distance the wave will travel. Shorter wavelengths at higher frequencies approach the size of dust and moisture particles in the atmosphere. These particles act as antennas at these shorter wavelengths, scattering and absorbing some of the energy of the wave. Therefore, attenuation is greater at higher frequencies. Figure 4-10 relates radar frequency to probable range capability.

Frequency (MHz)		Probable Range Capability
Low:	25 to 3,000	Long range
Medium:	3,000 to 5,500	Medium range
High:	Over 5,500	Short range

Figure 4-10. (C) Frequency and Probable Range Capability

4.8.1.6 (C) Type of Scan. Knowing the type of scan helps to determine the purpose of the radar. Figure 4-11 relates scan type to radar function.

Scan Type	Probable Radar Function
Palmer	Weapons control search
Circular	Search
Sector	Search
Helical	Land-based search (normally)
Vertical	Height finder
Raster	Weapons control or airborne fire control search
Spiral	Weapons Control Search
Conical	Precision tracking
Lobe Switching	Precision tracking
HOR/VER (TWS)	Search and weapons control

Figure 4-11. (C) Scan Type Relation to Radar Function

4.8.1.7 (C) Scan Rate. Scan rate can be used to further identify the function of a radar. Rate of rotation of circular scans is measured in seconds per rotation (SPR); sector scans are measured in seconds per scan (SPS); and conical, spiral and switching scans in Hz. (Figure 4-12 relates radar scan rate to probable function.)

Scan Rate (SPR)		Probable Radar Function
Slow:	20	Height finders, air search, early warning
Medium:	10 to 20	Height finders, ground control intercepts
Medium high:	4 to 10	Height finders, surface search, navigation
High:	2 to 4	Carrier controlled approach

Figure 4-12. (C) Scan Rate Relation to Radar Function

4.8.2 (C) Signal Evaluation Procedures. It is the responsibility of the equipment operator to determine the initial evaluation of the intercepted signal. The operator must do the following.

4.8.2.1 (C) Make an Initial Evaluation of the signal on the basis of its parameters and audio, using the guidelines in paragraph 4.8.1. If possible, evaluate function and platform of emitter.

4.8.2.2 (C) Record the parameters of the intercepted emitter including frequency, PRF, PW, antenna rotation rate, type scan, polarization, and any other identifying information.

4.8.2.3 (C) Compare these characteristics with those in the friendly and enemy emitters section of the EW annex to the OPORD or a threat emitter guide. If the parameters match one of these signals, this is probably the correct signal. In the event the parameters do not match or if no list of emitters is available, the operator, or preferably a trained ESM evaluator, will proceed with the evaluation as follows:

1. Check an appropriate reference document such as NWP 12-6-1, Threat Emitter Evaluation Guide, or NIS-1700S-00Z-(YR), Radiation Characteristics of Electronic Equipment, for emitters which have the detected characteristics. Ensure that all signal parameters coincide with the selected emitters.

2. Allow the following tolerance for operator error or equipment inaccuracies:

Frequency	- 1%
PRR	- 5%
PW	-10%
SPR	-Not specified, but error should be slight when a stop watch is used. Allowances must be made when determining SPR by any other method.

Many reconnaissance aircraft have laboratory capabilities to provide extremely accurate measurements. These capabilities are necessary to provide fingerprints and for in-depth analysis of new and unusual signals.

3. Correlate ESM information with other intelligence information such as current surface or air radar contacts, geographical location of both intercepting and intercepted units, and operating radars of intercepted air and surface contacts.

4. Make final decision as to nomenclature, type, and degree of threat.

4.9.4 (U) Theater Electronic Intelligence (ELINT) Centers. Theater ELINT centers are tasked with providing electronic intelligence based upon analysis of all available information in support of the national intelligence effort, theater commanders in chief, type commanders, and subordinates thereof. ELINT centers are not in the operational chains of command; however, they do provide data for use by operational commanders in the form of:

1. Message and hard copy electronic order of battle.

2. ELINT alerts.

3. ELINT operational reports (ELOs).

4. ELINT technical reports (ELTs).

In addition, theater centers can provide guidance and feed-back to those operational units forwarding ESM material for subsequent ELINT analysis. Guidance and feed-back is provided to assist those submitting units in achieving a more viable EW posture.

4.9.7 (U) Technical Guidance Unit. The Technical Guidance Unit (TGU) program, established and conducted in accordance with OPNAVINST 3430.15 series, is designed to enhance the fleet electronic warfare capability through technical ELINT collection guidance. TGU assistance is provided through on-board visits, ELINT briefing presentations, and analysis of training reports submitted by fleet units. TGU services may be requested directly from the nearest TGU in accordance with the Fleet Commander in Chief 3430.4 series Instructions.

CHAPTER 5

Jamming

5.1 (U) DESCRIPTION

Figure 5-1 shows the functional relationships of jamming.

5.1.1 (U) Definition

1. ECM is that division of EW involving actions taken to prevent or reduce an enemy's effective use of the electromagnetic spectrum.

2. Jamming is the deliberate radiation, re-radiation, or reflection of electromagnetic energy with the object of impairing the use of electronic devices, equipment, or systems being used by an enemy.

5.1.2 (U) Objective. The purpose of jamming is to deny the enemy full use of his electromagnetic sensors and control systems.

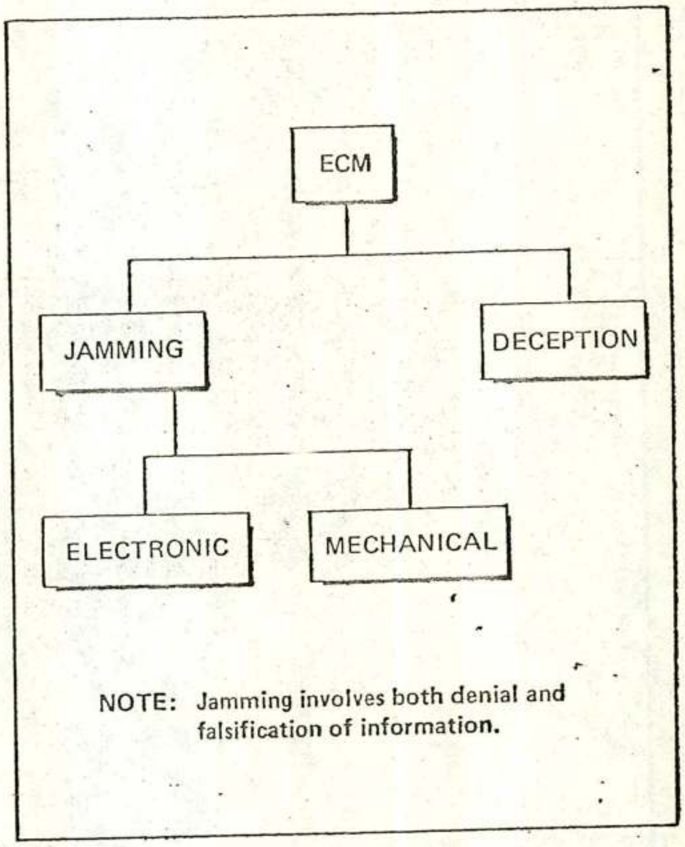


Figure 5-1. (C) Functional Relationships of Jamming

5.2 (C) JAMMING CONCEPT

(C) Jamming operations must be varied in accordance with the type of enemy equipment encountered. While intercept search is the same regardless of the type of enemy equipment in use, the tactical considerations governing jamming differ in some degree, depending on the equipment to be encountered and whether the measures are offensive or defensive in nature. Jamming is employed in connection with:

1. Radar countermeasures (RADCM)

2. Communications countermeasures (COMCM)

3. Missile and controlled devices countermeasures (MCCM)

4. Navigation countermeasures (NAVCM)

5. Electro-optical countermeasures (EOCM).

5.2.1 (C) Jamming Objectives. Jamming is used to deny the enemy the quality and quantity of information from his electronic equipment that would

enable him to prosecute successfully an offensive or defensive operation against opposing forces. Its use is based on one or more of the following:

1. Preventing or reducing effectiveness of enemy electronic tracking of friendly forces in a defensive posture or friendly attacking forces in an offensive operation

2. Denying the enemy accurate data for fire control, missile control, and bombing operations by completely masking targets or by transmitting erroneous range, bearing, and/or target composition information.

3. Reducing command and tactical control an enemy maintains through his communications network

4. Providing false information to an enemy's electronically controlled devices, thereby inducing errors or premature detonation

5. Depriving an enemy of accurate navigation information by deliberately jamming navigation aids

6. Threatening an enemy's identification security by jamming his IFF

7. Impairing an enemy's use of electro-optical devices, equipment, and systems.

5.2.2 (C) Electronic Jamming. Electronic jamming of enemy equipment is effective at varying ranges when using high power (brute force) masking jammers. Electronic jamming should not be used beyond maximum effective range since it will prematurely alert the enemy of the force's presence and hostile intent. Electronic jamming should be employed against those portions of the enemy's electronics complex that are most susceptible and will deny the most vital information. The most likely targets for electronic jamming are:

1. Fire control radars

2. Missile acquisition and control radars

3. Height finding radars

4. Ground controlled intercept (GCI) and early warning radars

5. Tactical communication nets.

Jammers should be activated when offensive forces are within normal detection range of enemy systems and should be used continuously throughout the offensive operation to deny or degrade information. Jamming against fire control and missile control radars should be initiated before attacking forces are within the lethal weapons envelopes of these systems.

(C) Electronic jamming by surface forces is conducted by those units capable of jamming operations and coordinated by the EWC. All units must have jamming equipment ready for immediate operation but must commence jamming only on specific order, thus ensuring coordinated operation and complete coverage of the desired frequencies. Guards are set on frequencies the enemy is most likely to use. An individual jammer is assigned to guard only a frequency band which it is capable of jamming continuously.

5.2.3 (C) Mechanical Jamming. Chaff and other reflecting devices are used to confuse and saturate enemy radars or radar-controlled devices. Friendly equipment as well as enemy equipment may be affected by reflecting materials, depending on the frequency and relative position of the reflectors and the friendly forces. Since the frequency response to reflecting materials is broader than electronic equipment, their use in close proximity to friendly forces or operations may create more confusion and degradation to friendly systems than their employment warrants. Use of reflecting devices for jamming is covered in paragraph 5.2.7.

5.2.5 (C) Basic Requirements. Jamming operations must be planned in detail before the commencement of operations. Prior consideration of jamming requirement will allow the planner to ensure that the appropriate equipment and accessory components are committed and that limitations are known and considered. The following requirements should be considered.

5.2.5.1 (C) Power Requirements for a successful jamming operation will vary according to the capabilities of the systems being jammed. Jamming transmitters need not produce the power that is required of a radar transmitter because jamming is a one way trip. Thus a jamming transmitter with only a few hundred watts of power may be capable of successfully denying information to a radar whose transmitted peak power is hundreds of thousands or millions of watts. The jamming power necessary need only exceed the power reflected from the target by an appropriate jamming to signal (j/s) ratio to be effective.

5.2.5.2 (C) Victim Receiver Bandpass. Many jammers have wide bandwidths over which the rated power is distributed. The bandwidth of the jamming transmitter may be variable from very wide band (1,000 MHz) to relatively narrow band (10 MHz) and is useful in providing jamming energy in a wide band multisignal environment. The effect of jamming against any single receiver is not a function of the total power radiated, but rather the total power radiated within the bandpass of the victim receiver. This bandpass may vary from very narrow (a few kHz) to very wide (up to 10 MHz). Intelligence concerning receiver bandpass is vital to jamming operations. Lacking such information, the planner may use known bandpasses of similar friendly equipment as a reasonable estimate. All power equation solutions should use only the portion of total radiated power within the victim bandpasses to provide estimates of capabilities.

5.2.5.3 (C) Jammer Bandwidth Distribution. Jamming power may be distributed over a wide band, but some types of power sources do not produce power that is of equal amplitude throughout the band. The planner must consider the characteristics of the power produced, and, in those cases where unequal power amplitude is being radiated in a particular band, he must provide for this limitation by committing sufficient power to do the job. He should commit multiple equipments to ensure that the "valleys" in power of a single transmitter are covered, modulate the radiated power with a sweep rate, or use another type of modulation as appropriate.

5.2.5.4 (C) Frequency Tuning. To be effective, any jamming signal should be tuned to the radiating frequency of the victim transmitter or, in special cases such as IFF, of the victim receiver. Monitoring of the victim emissions simplifies the task of frequency accuracy since the jamming signal need only be superimposed on the received signal. This is accomplished by the application of jammer-look-through, which allows the passive system time to monitor the environment while the active system jams. In those systems that are not accompanied by a passive receiving system, the accurate calibration of the frequency indicator is a necessary prelude to any active employment. Additionally, if a passive frequency monitoring system is not available, it is absolutely essential that accurate intelligence of expected threat emitters be available to allow productive use of jammers and that jammers be activated only within expected threat envelopes.

5.2.5.5 (C) Modulation Selection. Many jamming equipments incorporate a capability to employ some type of modulation of the basic radiated signal. These include sweep or single or multiple rates and pulse modulation. The selection of a sweep rate or a pulse modulation rate should be based on the operating characteristics of the victim equipment and the advantage that particular modulation rates will provide. In selecting a sweep or pulse modulation rate, the PRF, scan rate, and/or nutation rate of the victim should be considered. For use against victims with simple scan characteristics, selection of a sweep or pulsing rate that is a multiple of the PRF would be most desirable since this rate will produce strong amplitude returns at regular intervals on the victim displays, thus creating deception. Where sweep or

pulsing rates are too low to match PRF, selection of a rate that is equally divisible into the PRF would produce best results. For example, if the transmitter had a PRF of 300 and sweep rates up to 90 Hz were available, selection of a sweep rate of 75 Hz would be the best available rate to use since this rate would regularly generate false information on every fourth pulse. In equipment where very accurate matching is possible, slight mismatching will achieve good results. Mismatching should provide a few cycles more than or a few cycles less than the PRF to create moving deception targets on a victim display. For use against emitters employing complex scans such as AA fire control radars, sweep or pulsing rates that match the nutation/rotation rate will produce best results since this type of modulation will produce strong returns at regular intervals during each scan and will lead to confusing and/or deceptive information. Here again, slight mismatching of nutation/rotation rates will produce moving targets that may have the same results as the regular electronic deception type of equipment. Selection of the nutation/rotation rate for matching rather than the PRF on fire control radars is also more practical since PRFs used are usually so high (1,000 to 3,000 pps) that good matching is beyond jammer sweep rate capabilities, while nutation/ rotation rates are much lower (16 to 50 Hz) and are within the sweep rate capabilities of many jamming equipments.

5.2.5.6 (C) Jamming to Signal Ratio. Effective jamming is based on the fact that the jamming signal exceeds the target echo by some amplitude factor and is usually expressed in decibels (db). The j/s ratio requirements to effectively jam different radars will vary depending on:

1. Number of pulses integrated into the detection circuit

2. Receiver bandwidth

3. Pulse width of the radiated signal

4. Thermal noise ratio of the receiver.

Therefore, it is more useful to plan that a known j/s ratio will be achieved to a predetermined range. In selecting a j/s ratio, consideration should be given to the type of system being engaged. For example, a j/s ratio of 3 db at 10 miles may be sufficient to counter effectively an early warning radar, while a j/s ratio of 6 db at 4 miles may be required against a fire control radar. The planner should provide a jamming signal at the selected j/s ratio at the range necessary to accomplish the mission. By selecting a j/s ratio to be provided at a particular range, the planner is providing for sufficient jamming strength to ensure that little probability of detection exists beyond that range. He is not necessarily stating that detection will occur at that range since the actual detection range of the radar will be determined by equipment condition, operator training, operating mode employed, and other factors that he can neither control nor predict. Since the use of all power equations provides only theoretical "ball-park" figures, they should be considered as guides for planning rather than as absolute values.

5.2.5.7 (C) Burn-Through Range. The distance between the radar and the jammer is a highly important factor in jamming operations. As the distance increases, both jamming energy and radar echo energy reaching the receiver decrease. The radar echo energy decreases in proportion to the fourth power of the distance, while jammer energy decreases in proportion to the square of the distance. Because of this difference in decrease of power, jamming power needs to be but a fraction of radar transmitter power in order to jam the radar receiver. However, at some distance, varying with the size of the reflecting surface, power output of the jammer, power output of the radar, and other considerations, the radar echo energy will exceed jamming energy at the victim receiver. Within this distance, radar targets may be detected, as shown in Figure 5-2. If a jammer is being employed to prevent detection of a target at a range shorter than the jammer range, then the detection range or burn-through range of the target may be determined by use of the square of the jammer's range to the radar and the target's range to the fourth power in the basic power equation.

5.2.5.8 (C) Antenna Considerations. In addition to consideration of the directive gain of an antenna (paragraph 4.4), antenna polarization is a very

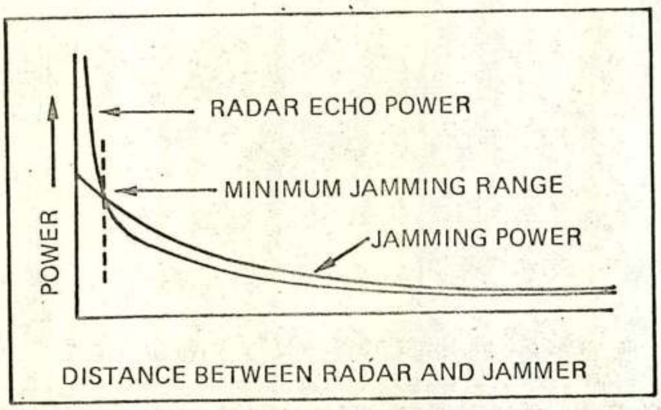


Figure 5-2. (C) Jammer Power vs Radar Power

important consideration in a jamming operation. Jamming energy will be most useful when the jamming signal is oriented or polarized in the same plane as the radar energy. Cross polarity (jamming energy in one plane and radar energy in the other) may result in jamming effectiveness as low as zero in theory; but since perfect polarization is seldom achieved in either radar or jamming signal, effectiveness would only be reduced rather than negated. Whenever possible, a jamming antenna of the same polarization as the intended victim should be selected. Since energy received is proportional to the cosine of the angle of difference between the two antennas, a slight angular difference would probably be of little importance while angles exceeding 60 degrees would result in loss of a substantial portion of the jamming signal to the victim receiver. Circularly polarized antennas are an acceptable compromise as an all-purpose antenna since they radiate energy with acceptable power reduction against linear, horizontal, vertical, and 45-degree polarizations. However, against circular polarization of the opposite handedness (that is, right-hand circular versus left-hand circular), the effectiveness is very poor. It is normally necessary to use a unidirectional antenna to achieve the jamming power at the victim receiver necessary to jam modern radars. As a general rule, it is desirable to select jamming antennas with the largest possible beam patterns consistent with directive gain requirements to allow more flexibility in maneuvering, particularly in aircraft. With the large lobe patterns, keeping the antenna properly oriented toward the intended victim is easier, yet the jamming vehicle retains the ability to maneuver within a less confining flight profile.

5.2.6 (C) Electronic Jamming Details. Jamming may be classified as self-screening or stand-off jamming. Any mode, spot, barrage, sweep, or swept lock, or any combination thereof, may be used in either type.

5.2.6.1 (C) Self-Screening. Jamming conducted by a force for the purpose of screening itself from enemy electronic detection is termed "self-screening" jamming. This technique can be employed by either aircraft or ships. Self-screening jamming is the most efficient method of radar masking when ships are involved because supporting units are not required. Figure 5-3 illustrates a technique that may be employed by a naval ship while performing a shore bombardment mission within the range of hostile shore batteries.

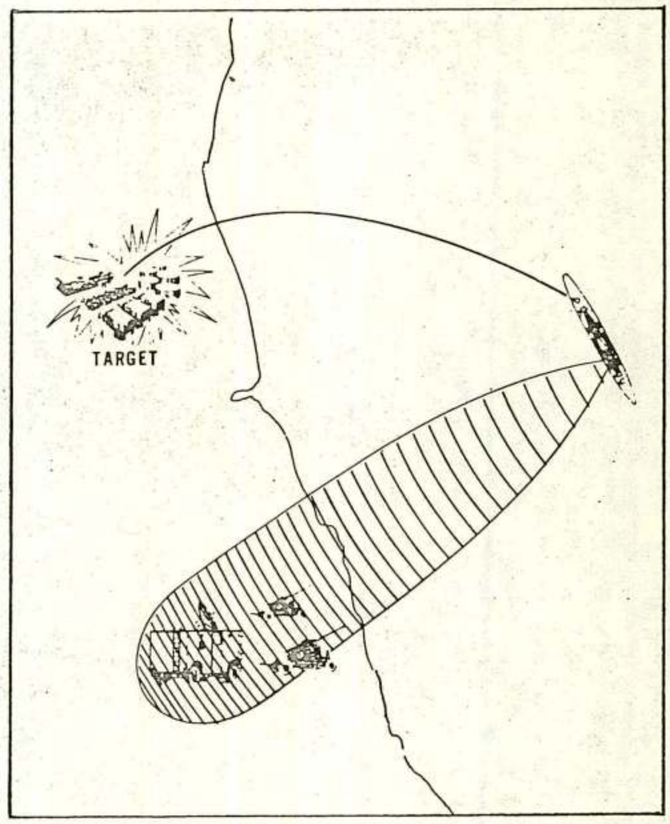


Figure 5-3. (C) Example of Self-screening Jamming

Airborne on-target jamming will be accomplished by strike aircraft with appropriate equipment installed to jam hostile emitters within the target area.

5.2.6.2 (C) Stand-off. The term stand-off jamming (SOJ) refers to jamming that is used to support or screen units (ships or aircraft) that are potential targets of enemy electronic detection devices when the jamming platform (ship, aircraft, or expendable unit) is not the immediate target. Stand-off jamming is sometimes referred to as off-target jamming.

Stand-off jamming is used primarily to support air operations. An airborne jamming platform supports, at a stand-off distance, attack/reconnaissance aircraft just prior to entry into and while within the weapons/radar surveillance envelope. Figures 5-4 and 5-5 illustrate two SOJ techniques employed in support of strike/reconnaissance operations. The radial penetration (Figure 5-4) has two phases — approach and retirement. The first SOJ covers the attack/reconnaissance aircraft during the approach entry and on-top target. The second SOJ covers the attack and retirement. The SOJ employed with the arcing penetration (Figure 5-5) screens the attack/reconnaissance aircraft during all phases. When SOJ is selected to cover attack/reconnaissance aircraft, close coordination is required between all units to ensure proper positioning to maintain continuous screening.

5.2.6.3 (C) Determining Effectiveness of Jamming. Determining the immediate results of jamming is a major problem in every operation involving ECM. This can be accomplished by:

1. Observing the effects of ECM on the enemy during the course of the operation

2. Watching the reaction of enemy units by radar or visual means

3. Noting the effectiveness of enemy gunfire or missile attack.

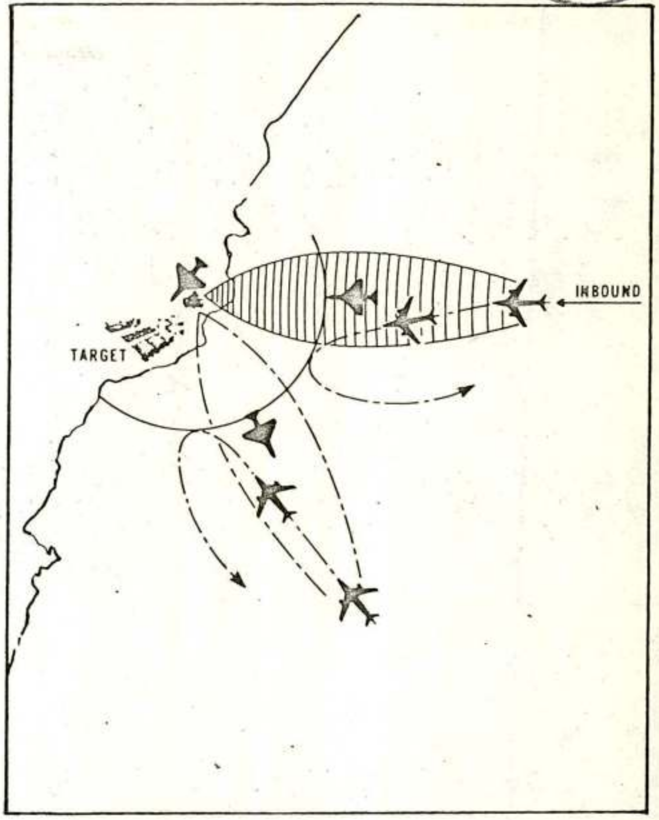


Figure 5-4. (C) Example of Stand-off Jamming (Radial Attack Method)

The first indications of effective jamming are normally apparent to the ECM operator when the enemy takes any ECCM action such as frequency shifting, mode shifting (circular scan to sector scan, and so forth), PRF or PW shift, or other detectable shift in mode of operations. In some radars, a shift from automatic track (lock-on) to acquisition or search mode may be noted. Absence of any detectable indications of effectiveness does not imply that jamming on that frequency is ineffective. The advent of another radar or activation of another circuit may mean that jamming is effective and that the enemy is hoping to use alternate equipment so the new frequencies will be unnoticed. Once committed to an operation and assuming that the equipment being jammed is an essential part of the enemy system, it is judicious to continue the jamming until the operation is completed.

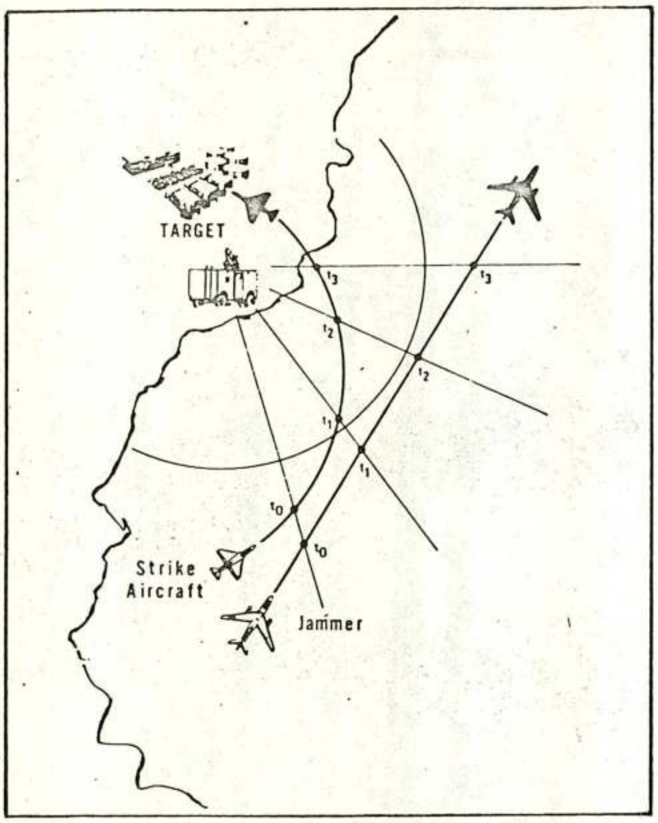


Figure 5-5. (C) Example of Stand-off Jamming (Arcing Attack Method)

5.2.7 (C) Nonelectronic Jamming Details. The use of nonelectronic jamming can serve to deceive an enemy as to direction of attack or numbers of attackers, or to conceal attacking forces.

5.2.7.1 (C) Operational Use of Chaff. Chaff and other nonelectronic jamming methods can be used to obtain a tactical advantage and may be employed by ships or aircraft. Units using chaff should ensure that friendly forces in the area are properly notified. This will prevent confusion and false evaluation.

5.2.7.1.1 (C) Aircraft use chaff to:

1. Destroy the accuracy of radar-directed antiaircraft fire and missiles

2. Prevent the enemy from obtaining accurate range and bearing data

3. Assist in evading enemy fighters

4. Achieve operational deception

5. Supplement the jamming equipment and chaff dispensing facilities of surface forces.

5.2.7.1.2 (C) Surface Forces use chaff to:

1. Protect surface units from enemy shore-based weapons systems

2. Achieve operational deception

3. Provide decoys for enemy active homing weapons

4. Present multipath problems to enemy ESM operator.

5.2.7.2 (C) Determining Coverage Requirements. Before chaff operations are conducted, information concerning the frequencies, pulse widths, and estimated beam widths of enemy radars to be jammed must be known. While chaff is essentially a broad band countermeasure, to ensure adequate coverage it is necessary to use different lengths when the various radars to be countered are in widely separated frequency bands. It must also be used in varying amounts. The calculations in the following paragraphs shall be used to determine both length and quantity of chaff.

5.2.7.2.1 (C) Length of Chaff. Since chaff is resonant over a fairly wide band, painstaking effort to cut it accurately is not necessary. Chaff cut to lengths equal to about 0.475 times the wavelength of the victim radar is usually effective as an average length. The formula below may be used if it is desired to determine the length of the dipoles in inches when the frequency to be jammed is given in MegaHertz.

$$\text{Length of dipole in inches} = \frac{5{,}610 \text{ (Constant value)}}{\text{Frequency in MegaHertz}}$$

5.2.7.2.2 (C) Quantity of Chaff. To be effective, chaff should be used generously. In some cases, it appears on radar screens as individual blips similar to those produced by aircraft. In other cases, a long mass of blips may appear close together. A skilled radar

operator can often tell the difference between an aircraft blip and a single blip produced by chaff.

(C) Chaff is packed in units of various lengths and quantities, with each unit applicable to a given frequency. Packages are dropped at intervals frequent enough to make it impossible for an operator to separate a single blip of an aircraft from the mass of chaff echoes. Aircraft following the chaff-laying aircraft are thus protected from radar-controlled antiaircraft fire and concealed from air search radars. However, radars with a moving target indicator (MTI) feature have the capability to decrease greatly the effectiveness of chaff.

(C) The quantity of chaff to be used in each drop depends on the frequency of the radars and the size of the target or targets to be screened. A fundamental principle of nonelectronic jamming is that good screening results when there are the same number of chaff areas per pulse packet as there are aircraft or ships per pulse packet. The pulse packet is defined as a volume which is one pulse width in length, one horizontal beam width wide, and one vertical beam width high. It may be considered as the total radiation emitted by a radar transmitter during one pulse. The pulse packet for any particular radar signal has a constant length in range from the radar of approximately 500 feet for each microsecond of pulse length. Horizontal and vertical beam widths vary with the distance from the radar and may be approximated with the following formula:

$$W = \frac{\text{HBW} \times \text{Range}}{60 \text{ (Constant value)}} \quad \& H = \frac{\text{VBW} \times \text{Range}}{60 \text{ (Constant value)}}$$

where W = Width of pulse packet in yards
H = Height of pulse packet in yards
HBW = Horizontal beam width in degrees
VBW = Vertical beam width in degrees
Range = Distance to radar in yards.

Figures 5-6 through 5-8 illustrate the appearance of an aircraft (or chaff) on a radarscope. Figure 5-6 shows that targets separated by one-half pulse length or less appear as a single target on the radarscope. Figure 5-7 shows that when two aircraft are one-half pulse length apart and are approaching the radar, the two pulses return to the radar nose-to-tail and are

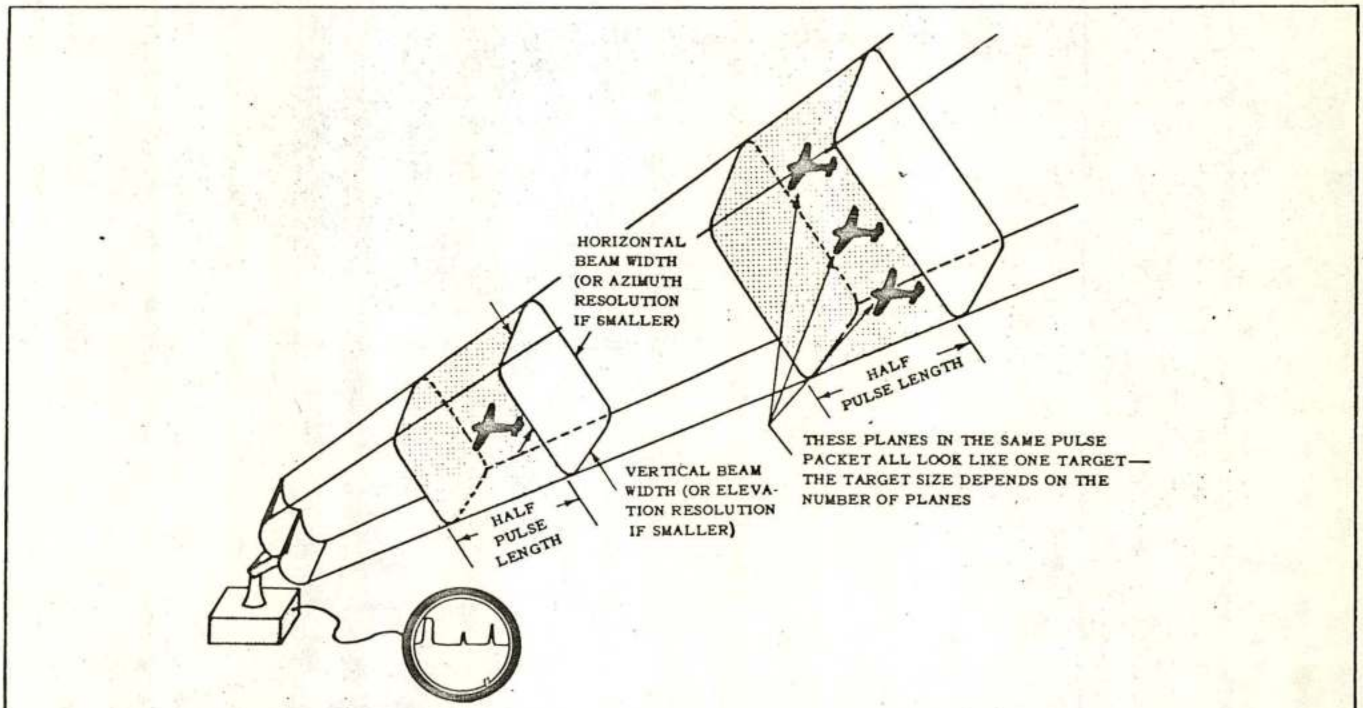


Figure 5-6. (C) Target Separation Effect on Scope Resolution

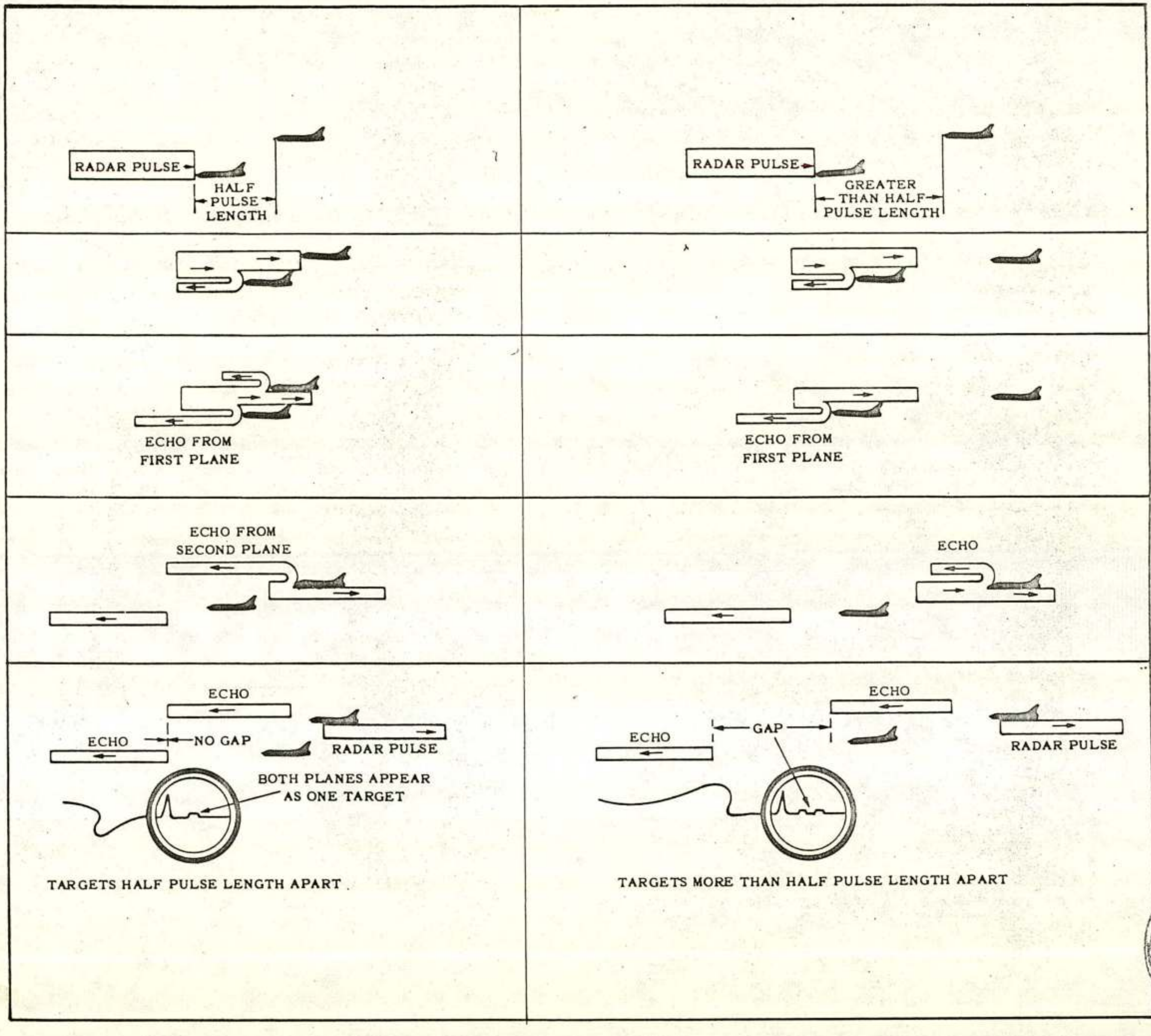


Figure 5-7. (C) Echo Pulses of Spaced Targets

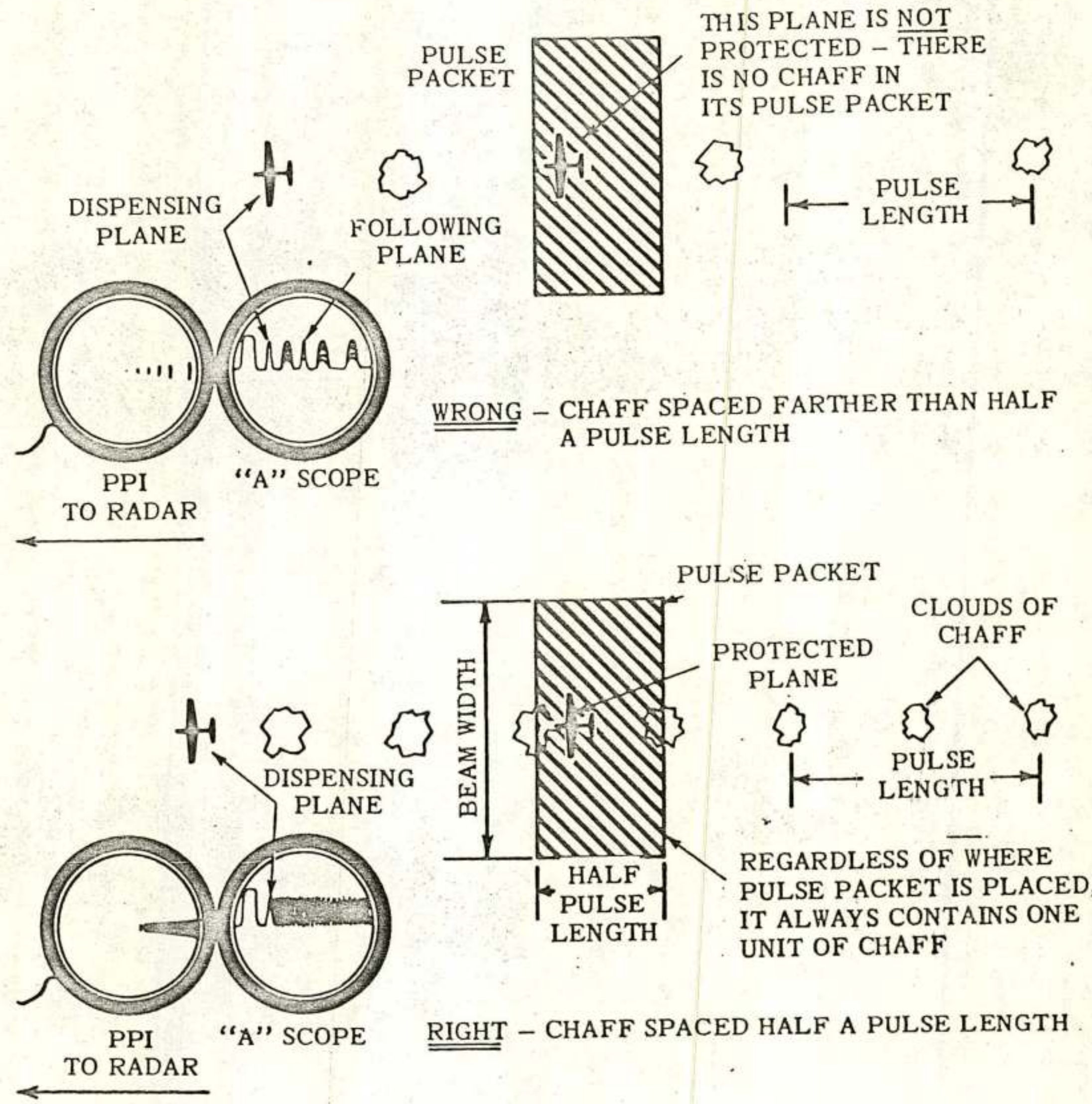


Figure 5-8. (C) Effect of Chaff Spacing

displayed as a single return. With greater aircraft or chaff separation, as shown in the right-hand column of Figure 5-7 and in Figure 5-8, two blips are formed on the scope. Because the radar detects separate blips when targets are more than one-half pulse length apart, chaff should be dropped so that there will be a continuous screen. Depending on the tightness of own formation and size of the pulse packet, varying numbers of aircraft and ships may be within a pulse packet at any one time. Therefore, the number of dipoles necessary to screen the radar echo must be multiplied by the number of units (aircraft or ships) which are within the limits of a pulse packet at any one time.

5.2.7.2.3 (C) Dispensing Chaff. Chaff must be dispensed at a distance sufficiently ahead of and above the forces to be screened so that the forces are covered at the time jamming (screening) is desired. Plans for dispersal patterns should be based on:

1. Wind conditions
2. Type of reflector material to be used
3. Time element
4. Number and disposition of units to be screened.

Reflectors dispersed at too low or too high an altitude may be insufficiently scattered to have optimum jamming effect and may permit radars or missiles to detect true target echoes through the chaff pattern. Dispersal patterns must be continually renewed if screening is desired over an extended period. Flights renewing the pattern should sow the same chaff pattern as the previous flight. This will increase the intensity of the pattern and make it more effective. If enemy radars are concentrated in the same area and have approximately the same electromagnetic characteristics, their number is not a consideration in planning for the dispensing of chaff. However, against radars having widely different characteristics, the chaff drop pattern should be calculated on the worst case (that is, the pulse width that will normally be most restrictive). The chaff drops should be spaced for the narrowest pulse widths that will be encountered. It is preferable that aircraft drop only one type of chaff.

(C) Whether chaff is to be used against an enemy task force or against a heavily defended shore installation, the problem is essentially the same. The area through which attacking aircraft are to maneuver must be so thoroughly infested with chaff that individual aircraft or ships cannot be tracked or ranged on by enemy radars.

(C) The pulse length of a radar determines its range resolution and establishes a definite radial spacing for chaff drops. The beam width determines the bearing resolution and establishes the required drop spacing in azimuth. If chaff drops are planned in accordance with this paragraph, the enemy radar becomes useless for locating targets in the area covered. However, various factors usually prevent dispensing an ideal pattern and a compromise must be accepted. The compromise may result in more chaff than is necessary in one area and not enough in others.

(C) Chaff dispensing capabilities are usually limited by the dispensing units available and the quantity of chaff required to maintain patterns for prolonged periods. Additionally, the enemy radar capability to read through (MTI) may negate the operational use of chaff on a large scale. An acceptable tactic is known as "pre-seeding" which involves dispensing random bundles of chaff throughout an area prior to an attack. This creates false target and may severely degrade the radar operator's capability to detect targets in the midst of the cluttered scope. When used well in advance of a strike, this technique tends to fatigue the operators. Chaff is most successful against fire control and missile control radars. For this purpose, it may be dropped at a random rate in an effort to break track, create false targets, and preclude automatic target tracking rather than attempt to screen forces. Since manual tracking by fire control radars is less accurate than automatic tracking, chaff can degrade enemy equipment performance and create conditions in which fire accuracy is lost. Chaff used against antiaircraft and missile fire can also cause premature detonation of proximity fuzes by false target passage information. Chaff is also useful to confuse enemy interceptors by presenting false targets, thereby enabling friendly aircraft to take evasive action. The use of chaff with warning receivers in aircraft constitutes an acceptable defensive system since the receivers indicate visually or aurally the presence of a threat signal and either automatically dispense chaff

or afford the aircrew the warning necessary to dispense chaff bundles and commence evasive maneuvers.

(C) When own units are approaching an enemy radar on a radial course, the problem of drop spacing is simple. The interval for dropping is the length of time it takes the despensing aircraft to travel the length of one pulse packet. The problem can be solved by applying the formula in Figure 5-9 or by reading directly from the chart. When calculating drop intervals against radars employing pulse compression, the width of the compressed pulse must be used in the formula vice the overall radar pulse width. The width of the lane to be jammed is determined on the basis of the area occupied by the units to be screened and the range to the radar. If the number of dipoles per drop or salvo is sufficient to produce an echo equivalent to the combined echo of all the units within the limits of one pulse packet at the range in question and if the formation is such that not all units are within one pulse packet in bearing, it is only necessary to duplicate the drop azimuth or salvo adjacent pulse packets. Similar considerations apply in connection with range and elevation.

(C) When own units are approaching at an angle to the radar beam, drop spacing is more difficult to determine. A lane must be established at an angle to the radar beam. If dispensing units are unable to approach the enemy close enough to establish this lane, a radial lane is essential. To permit effective sowing of chaff, this lane should intersect the entire beam width of the radar. The diagonal distance (ab) can be found by using the formula:

$$ab = \frac{W}{\text{SIN } \emptyset}$$

where ab = distance
W = Horizontal width of pulse packet in yards
$\emptyset$ = Relative angle between direction of radar and direction of chaff lane.

Figure 5-10 illustrates the use of this formula.

(C) The average rate of fallout of chaff is 100 to 300 feet per minute depending on wind conditions. When dispensed from above 10,000 feet, however, average rate is approximately 400 feet per minute. The fallout rate varies with the horizontal movement of the material, which is approximately the same as the prevailing wind at the particular altitude. When chaff is dispensed from high altitudes, it may be widely dispersed long before reaching the surface, thus decreasing the effectiveness of the pattern.

(C) Chaff reaches its maximum effectiveness about a minute after it is dropped from an aircraft or ejected from rockets, except that chaff ejected mechanically from high speed aircraft blossoms very rapidly (5 to 10 seconds after ejection). Effects may be expected to last from approximately 30 minutes to several hours when dispensed from appropriate altitudes.

(C) In determining the drop altitude, the purpose of the chaff sowing must be considered. Normally when the material is dispensed from projectiles to screen surface forces, the projectiles are set to burst at about 2,000 feet. When used to screen aircraft, the altitude of the dispensing aircraft should provide sowing at the altitude of the attacking aircraft. For torpedo or strafing attacks, the chaff screen should be dropped from an altitude no higher than 5,000 feet. Such attacks are usually of short duration, and the timing of the chaff drop is highly important. For level bombing attacks, the height of the bombing run determines the altitude of the chaff drop.

5.2.7.2.4 (C) Procedures for Dispensing. Aircraft dispense chaff by automatic dispensers or rockets. Ships use projetiles and mortars for chaff dispersal. See Chapter 7 for surface system descriptions and Appendix B for chaff placement information. Most chaff dispensed by aircraft is prepackaged in units of suitable size for dropping and is either automatically or manually dropped. The rate of drop is usually controllable by the aircrew involved. Rockets are also used when it is desired to screen the dispensing aircraft.

5.3 (C) EMPLOYMENT

(C) Jamming is employed when the tactical advantage of emission control and silence is outweighed by the possible advantages of transmitting and introducing electromagnetic emission energy into enemy receiving systems. It is

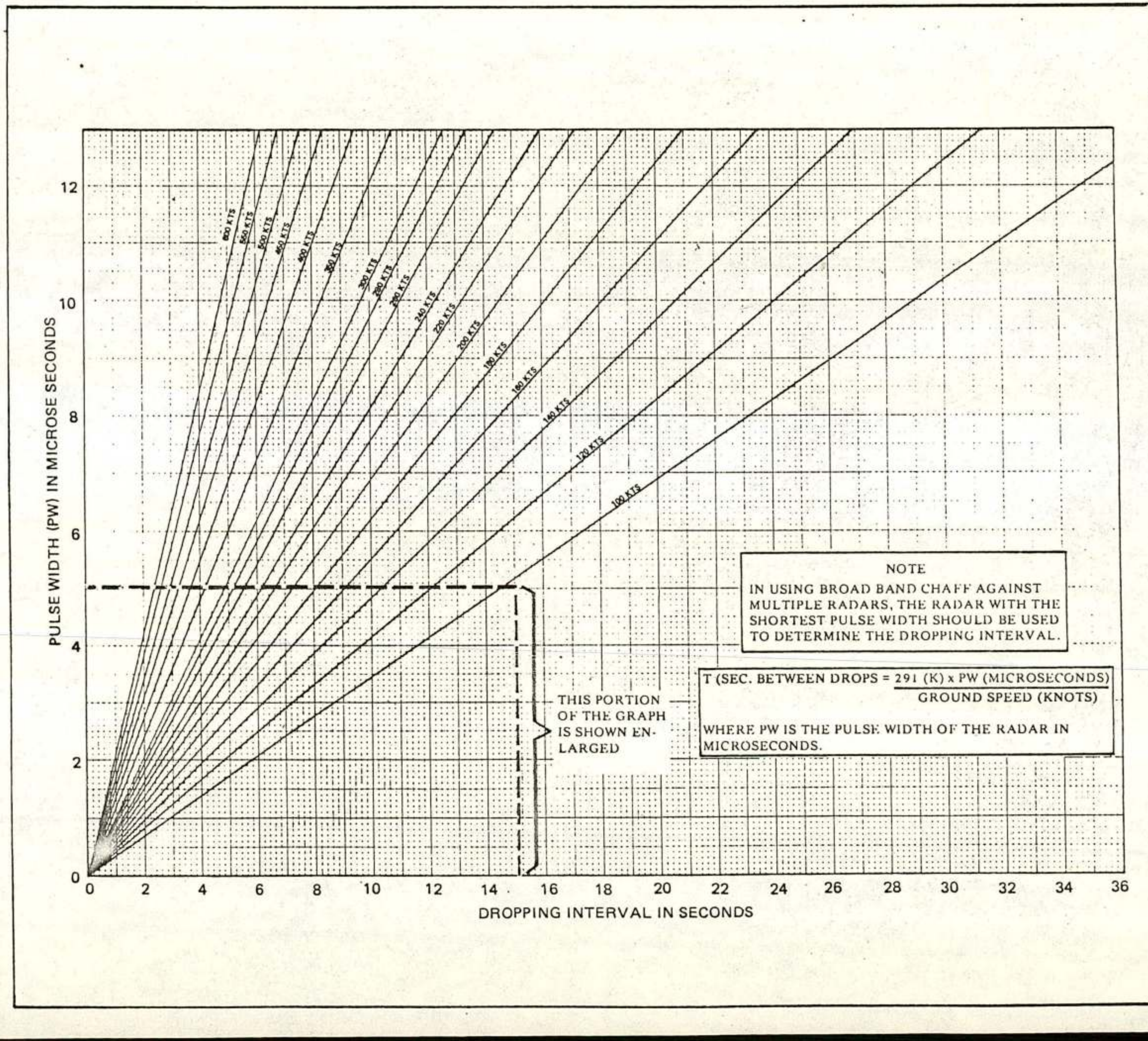


Figure 5-9. (C) Chaff Dropping Interval

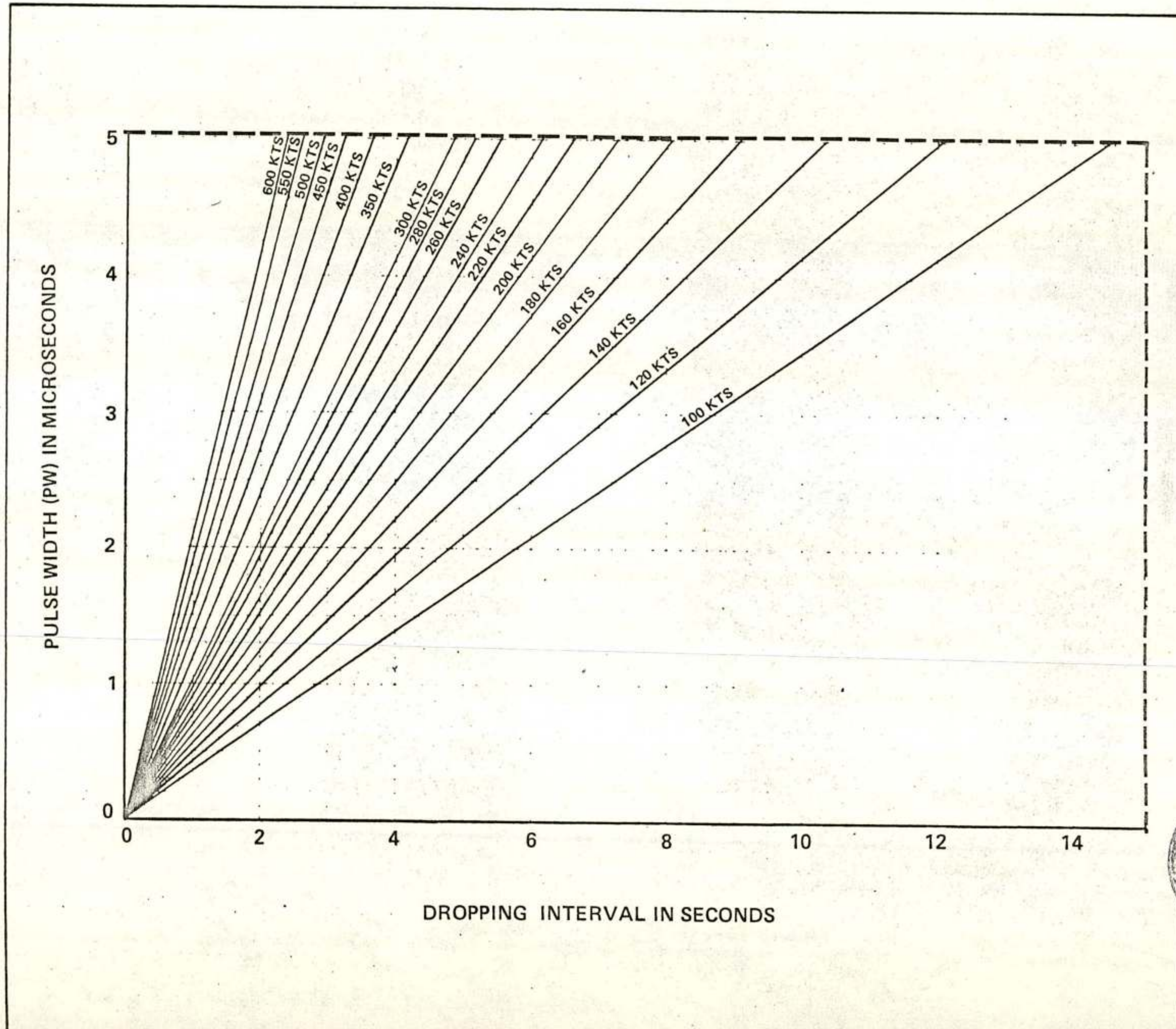


Figure 5-9. (C) Chaff Dropping Interval (Cont.)

DROP COMPUTATION

Given:

Relative angle between aircraft dispensing unit and direction of chaff lane is 40 degrees.

Range between aircraft and enemy radar is 6,800 YD.

Radar characteristics—frequency 200 MHZ, pulse width 3 microseconds, horizontal beam width 30 degrees.

Speed of aircraft is 200 knots.

Solution:

Radial length of pulse packet = pulse width (3 microseconds) x pulse length per microsecond (500 FT) = 1,500 FT (500 YD.)

Width of pulse packet (W)=

$$30 \text{ (HBW)} \times \frac{6{,}800 \text{ (range)}}{60^{*}} = 3{,}400 \text{ YD.}$$

Distance (ab) traveled by aircraft in crossing radar beam =

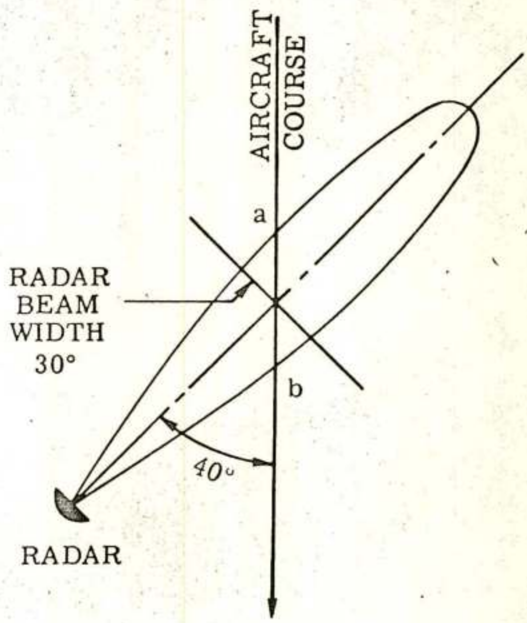
$$\frac{3{,}400 \text{ YD. (W)}}{0.643 \text{ (sin } \theta)} = 5{,}287 \text{ YD.}$$

$$\text{Number of drops} = \frac{3{,}400 \text{ YD. (the width)}}{500 \text{ YD. (the length)}} = 7$$

Time interval between drops (T) =

$$\frac{5{,}287 \text{ YD. (the distance)}}{111 \text{ YD.}^{**} \text{ sec} \times 7 \text{ (the number of drops)}} = 7 \text{ (approx.)}$$

Therefore T = 7 sec.



* Constant value

** At a speed of 200 knots the aircraft will travel 111 yards per second

Figure 5-10. (C) Chaff Drop When Approach Lane is at an Angle to the Radar Beam

primarily employed against electronic equipment which is known or strongly suspected to be furnishing information to the enemy. Where possible, jamming and deception should be used in combination. The use of deception techniques, in lieu of jamming, should be considered when the enemy equipment has a home-on-jam (HOJ) capability.

(C) The acceptance of the false information by enemy systems provides protection by causing misses and useless expenditure of weapons. Systems that incorporate HOJ will automatically home on the jamming source when denied useful information but may readily accept deceptive information. The value of jamming is increased by the element of surprise and by darkness, weather conditions, or battle conditions which force the enemy to rely heavily on his electronic equipment. A variety of countermeasures should be employed since enemy operators will readily identify and overcome stereotype tactics.

5.3.1 (C) Planning Considerations. Careful planning is essential for the effective use of jamming. It ensures the necessary coordination and minimizes the interference which can be created in friendly systems. ESM and intelligence publications furnish information on the technical and operating characteristics of enemy equipment. In addition, a thorough knowledge of own force capabilities is required to ensure that planning provides maximum protection.

5.3.1.1 (C) Importance of ESM, Intelligence, and Tactical Update. Before jamming operations may be planned in detail, accurate and complete EWI must be available concerning enemy electronic systems. In the preliminary stages, it is necessary to use available information concerning the types of enemy equipment, their operating characteristics, modes of operation, and their probable geographic disposition. For specific operations, it is essential to update general intelligence as completely as possible to ensure that accurate assessments of capabilities and vulnerabilities may be considered in the assignment of specific tasks. A complete up-to-date picture of the enemy's concentrations and dispositions will allow the planner to take advantage of the weaker links in the total system. In cases where sufficient equipment is not available to totally neutralize an enemy's capabiliy, it is essential to concentrate available assets on those areas that provide the most valuable operational information.

5.3.1.2 (C) Consideration of Own Forces. Planning considerations must include a determination of the friendly equipment and frequencies that are vital to the success of an operation and a jamming plan that will not dangerously deny or degrade the performance of this vital equipment. The size and shape of own formation influence jamming effectiveness.

5.3.1.3 (C) Configuration Considerations. Operational planners must be aware of equipment capabilities and limitations of all units and, particularly, limitations imposed on aircraft because of optional equipment configurations that are available. An estimate of the essential jamming requirements must be made, and configuration requirements must be promulgated so that proper operational equipment may be selected, tested, installed, and used in support of jamming operations.

5.3.2 (C) USE BY VARIOUS UNITS

Methods of using jamming are governed by the:

1. Tactical situation

2. Mission of the force

3. Types of ships and aircraft available for the operations.

Surface ships, aircraft, and submarines each have peculiar advantages for use of jamming. There are tactical applications for which each is best suited.

5.3.2.1 (C) Surface Ships have the advantage of carrying more powerful jammers because of fewer

strictions on size, weight, and power available. However, when ships are operating jammers against surface radars, the radar horizon limits their coverage capability to relatively short ranges from enemy installations. Additionally, because of the short ranges involved and large reflecting area of the surface ship, the jammer may not be effective in masking its own radar return. Continuous noise jamming, while capable of denying position information, is susceptible to hostile HOJ operations and thus is less desirable than deception devices for shipboard defensive operations. Electronic jammers are most valuable in denying fire control information to enemy forces when ships are operating within hostile gun envelopes. The following operations may be performed by surface ships:

1. Defensive jamming for self-screening against enemy surface search radars and for protection against enemy fire control radars, radar-equipped aircraft, guided missiles, and proximity-fuzed projectiles and missiles

2. Electronic jamming for screening other units from enemy radars

3. Electronic jamming and/or deception to disrupt enemy communications, IFF operations, or reception from navigation aids

4. Dispersal of shell or rocket chaff patterns for self-screening from enemy search or fire control radars and to create false information for guided missiles

5. Electronic deception to confuse enemy radar systems by presenting false target echoes or by enhancing the return of a small ship to make it appear as a major combatant

6. Release of floating radar decoys to simulate a larger group of ships or to simulate presence of a force after its departure from an area.

5.3.2.2 (C) Aircraft

5.3.2.2.1 (C) Advantages

1. Speed

2. Maneuverability

3. Ability to reach positions untenable by surface forces

4. Increased antenna height.

5.3.2.2.3 (C) Tactical Employment. Aircraft employing self-protection on-board jammers are constrained according to the type of jamming employed.

(C) On-board noise jamming will defeat automatic tracking systems and will deny range to manual mode operators. However, a manual fire control solution on a single aircraft employing noise jamming may be derived using passive azimuth and elevation information (jamming energy strobes) and a prior knowledge that the target is within range. This passive angle tracking technique is particularly effective when employed by a track-while-scan missile system firing proximity fuzed missiles. Thus, a single noise jamming aircraft may be vulnerable; however, a formation of noise jamming aircraft maintaining a rigid formation that takes advantage of the centroid effect discussed in paragraph 6.4.3 (multiple targets within a single resolution cell of the radar) will receive

significantly greater protection. In this situation, formation integrity must be maintained; any individual aircraft departing the formation will become a resolvable individual target and become highly vulnerable.

(C) Deception jamming is more insidious and will induce subtle angle and range errors in fire control radars. Deception may or may not force these radars out of automatic mode, and will provide protection for a single aircraft. Radars forced out of mode by deception may be operated in manual mode. Manual mode is normally a degraded mode of operation, but is still a potentially lethal mode. The combination of deception jamming and evasive maneuvering is an effective tactic for deception jammer-equipped aircraft.

(C) Systems currently under development will employ dual mode jamming (high peak power for deception and high average power for noise jamming) and will provide a capability to sequence between noise and deception, thus defeating both automatic and manual tracking modes in fire control systems.

For additional information of EA-6 capabilities and stationing procedures, see Appendix B.

5.3.2.3 (C) Submarines. The use of jamming by submarines is limited to the aquatic spectrum because the submarine's primary advantage is the ability to remain undetected in nearly all operations. Sonar/acoustic jamming or noise making may be considered as an ASW screening/concealment tactic for high value units.

5.3.3 (C) Jamming in Various Types of Operations. Effective use of jamming will be determined by the tactical situation. Jamming may be used during:

1. Air strikes
2. Antiair warfare
3. Amphibious assault
4. Enemy guided missile attack.

It may be used during shore bombardment but would not usually be used by aircraft or submarines conducting ASW or reconnaissance operations. (See Figure 5-11.)

5.3.3.1 (C) Antiair Warfare. The use of jamming will be determined by whether own force has been detected. If the force has not been detected, jamming will increase the possibility of early discovery. However, if the force has been visually sighted or detected by enemy radar, the use of jamming will materially deter the enemy from tracking.

(C) If early warning information has indicated the type of enemy attack and if enemy dependency on electronics has been observed, jamming and/or deception should be used. Care must be taken to prevent inadvertent jamming of own radars, air control and information nets, or early warning relay links on which coordinated efforts depend.

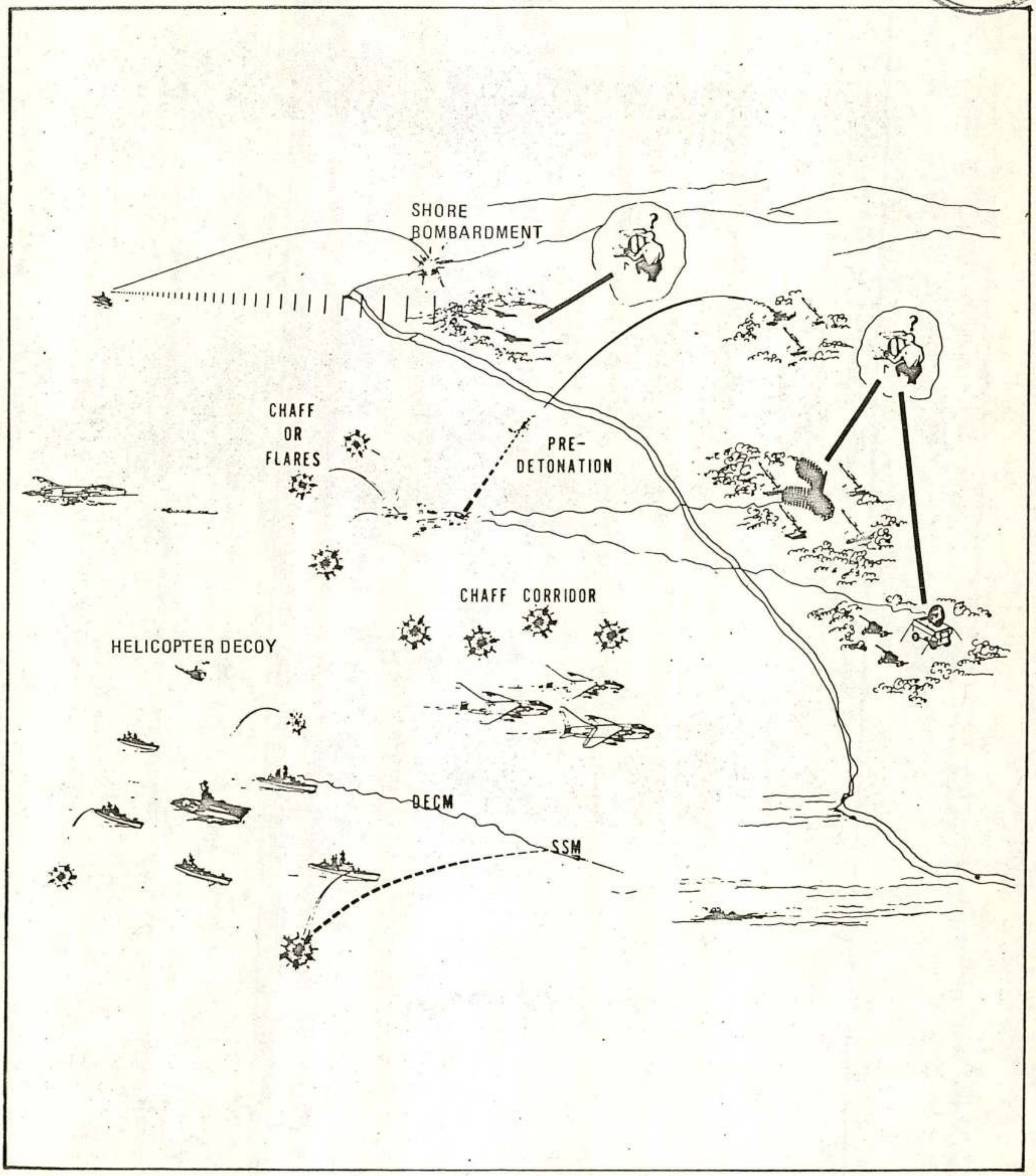


Figure 5-11. (C) Jamming Objectives

5.3.3.3 (C) Amphibious Assault Operations normally do not take place until neutralization of the beachhead has been accomplished. Electronics are used for coordination of:

1. Landing operations
2. Naval artillery barrages
3. Antiair warfare.

If intercept search operations have been effective, shore-based radars and fire control systems should have been located and destroyed during the neutralization phase. Air and surface pickets are used to establish an outer line of defense at some distance from the attack area.

(C) In amphibious operations, electronic jamming may be used to neutralize shore-based radar sites, to counter enemy missile guidance systems, and to support deceptive tactics or demonstration landings. Enemy communications, including civil broadcast bands, also will be likely targets for communications jamming.

5.3.3.4 (C) Countering Guided Missile Attack. Attack by guided missiles may be observed by early warning radar, search radar, or fire control radar, but is most likely to be indicated by intercept search receiver. Because of the speed of the missiles and the short time available to jam guidance and homing systems effectively, operations and equipment must be in a high state of readiness to apply the proper jamming or deception immediately after evaluation. Since guided missile systems may incorporate an HOJ capability, jamming should be controlled to defeat HOJ or should only be used on non-HOJ capable missiles. Electronic deception devices designed to operate against this class of targets will generally provide the most protection against the terminal homing phase of a missile attack. These devices must be in standby condition at all times and, since they are capable of automatic response, should be in automatic mode at any time a threat is suspected. Electronic jamming may be best employed by airborne units to prevent the target acquisition necessary as a prelude to the missile attack while threat destruction is accomplished by friendly aircraft or missiles. Timely employment of chaff shells or projectiles can produce a remote decoy for a missile. Chaff can be employed in conjunction with active devices or by itself. Familiarity with intelligence information on characteristics of missiles and associated equipment is a mandatory requirement for all equipment operators.

5.3.3.5 (C) Shore Bombardment. ECM is normally used to nullify the effects of enemy radar-controlled shore batteries. The use of electronic and mechanical jamming will depend on the frequencies in use by fire control systems.

5.3.3.6 (C) Antisubmarine Operations. An EMCON plan allowing very limited radiation of electronic equipment is often necessary during ASW operations. Jamming will alert submarines to the presence of ASW forces and may well confirm to them that a threat exists. However, deception may be used to conceal the true nature of the ASW forces.

5.4 (C) COMMUNICATIONS JAMMING

Jamming of communications may be desirable in many circumstances. However, it is necessary to weigh all factors before making the decision to jam. Communication jamming can:

1. Prevent the enemy from normal use of his communications facilities
2. Aid our deception or radar jamming operations
3. Prevent or delay enemy relay of information detrimental to our forces.

However, it can cause the loss of valuable information that might have been obtained by listening to enemy communications; and it may block friendly channels of communication.

5.4.1 (C) SHORT DISTANCE JAMMING

Communications jamming transmitters, if properly used, can be very effective against:

1. Ship-to-shore command nets
2. Vehicle communication systems
3. Ground communication systems
4. Other relatively short-distance communication channels.

Jamming of communication circuits of any kind must be coordinated with the activities of intelligence services that may be using the channels to obtain information concerning the enemy.

(C) If enemy use of communication circuits is unknown or uncertain, an operator will be required to identify circuits prior to jamming. Under some conditions, the frequency bands of the enemy signals may be well known and not adjacent to our own bands, in which case there is no need for continual identification.

5.4.2 (C) Surface-To-Air-Jamming. Jamming of enemy surface-to-air communications is an effective means of neutralizing enemy air intercept control systems. Figure 5-12 illustrates the approximate radius outside of which a jammed area exists in respect to SOJ distance to a GCI site. Such jamming can be as effective as radar jamming since failure to transmit proper instructions to an interceptor destroys the usefulness of the aircraft control system. Jamming of surface-to-air circuits may be accomplished by airborne jammers in the vicinity of enemy transmitters. High-powered ground-based communications jamming equipment using directional antennas may transmit signals into a region where enemy interceptors are operating. This may not jam the air-to-surface link but will jam the more important surface-to-air link.

5.4.3 (C) Use of CW Jamming. A CW carrier may be used to jam enemy communication channels. Against teletype channels operated by skilled personnel, the CW jamming signal must be accurately tuned so that the difference in frequency between the desired and undesired signals is within 2 to 10 Hz. It must be keyed at the same rate or slightly faster than the victim signal.

(C) In telephone channels, the intermodulation products that result from the presence of an undesired CW carrier can prevent intelligible reception. The optimum difference in frequency between the desired and the undesired carrier for maximum telephone jamming is in the vicinity of 500 Hz. In these two types of communication channels, CW interference is effective only with strong spot jamming accurately adjusted to the optimum relative frequency.

(C) Arrangements may be incorporated in radio receivers to cope with CW jamming. Even when such precautions have not been taken, readable indications often may be obtained through a considerable amount of CW jamming by judicious operation of the various controls. If the same amount of radiated energy can be made available in the form of a suitably modulated signal, the jamming will be much more effective.

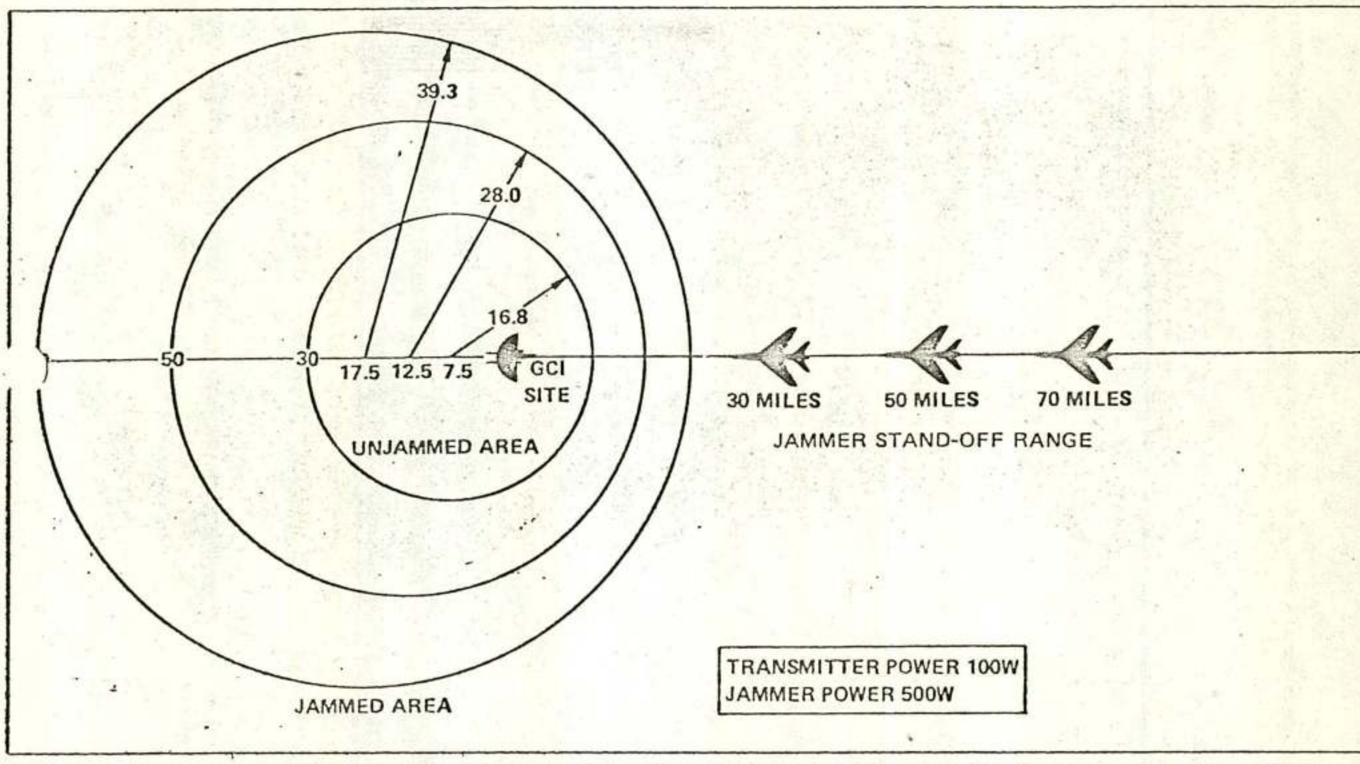


Figure 5-12. (C) Jamming of Surface-to-Air Communications

5.6 (C) JAMMING OF NAVIGATION AIDS

(C) If intelligence indicates that the success of our force missions will be affected by the enemy's use of his navigation aids, the EW appendix of the operation plan should include the requirements for navigation countermeasures.

(C) Navigation countermeasures consists of jamming and/or deception to interfere with enemy use of navigation aids. Navigation countermeasures require a knowledge of the frequencies used by enemy navigation equipment and information on the location of enemy beacons and similar installations. This information is provided primarily by advance intelligence and supplemented by on-the-scene ESM.

(C) Jamming is used against enemy navigation aids only when our forces cannot derive greater advantages from such aids for their own navigation, homing, and other functions.

CHAPTER 6
Deception ECM

6.1 (U) DESCRIPTION

Electronic warfare deception is a function of ECM and is a companion to jamming ECM (See Figure 6-1).

6.1.1 (U) Definitions. Deception ECM (DECM) is the deliberate radiation, re-radiation, alteration, absorption, or reflection of electromagnetic energy in a manner intended to mislead an enemy in the interpretation or use of information received by his electronic systems. There are two categories of deception:

1. Manipulative deception is the alteration or simulation of friendly electromagnetic radiations to accomplish deception.

2. Imitative deception is the introduction of radiation into enemy systems which imitate his emissions.

6.2 (C) CONCEPT

(C) The purpose of deception ECM is to mislead an enemy by electromagnetic means and thus reduce the effectiveness of his electronic systems. The ultimate result must be to minimize or eliminate the destructive capability of enemy weapons systems. The time to initiate deception measures and the duration of employing them is of paramount importance if full effectiveness is to be realized. If activated too soon, DECM can reveal the presence of the unit or force using it. Applied too late, the DECM may be obvious and thus the deception is a failure. In some cases, the employment of deception is required for only a limited period of time. This would be the case with a carrrier striking force. The enemy must destroy the carrier before its aircraft are launched if an attack is to be prevented. Applying deception measures to make small ships and boats appear as carriers to enemy sensors would force him to use other means to determine the true target. Such multiple target deception may gain the time necessary to ensure that the strike mission is launched.

(C) Electronic warfare cover is action associated with deception. It is designed primarily to supplement security and to prevent the recognition of force capabilities, dispositions, and intentions. Cover and concealment are intended to maintain the enemy in a state of ignorance, whereas deception embraces active measures which can induce an enemy to make an erroneous estimate of the situation. Cover is enhancement to security. Thus, it may prevent an enemy from obtaining information which could reveal the hoax of a deception plan. For this reason, cover is an essential element to EW deception.

6.2.1 (C) Meaconing, Intrusion, Jamming, and Interference (MIJI). Although these terms cover a variety of different electronic warfare techniques, they are grouped together for reporting purposes. Many of the enemy operations in this area involve deception. Although the Soviets have demonstrated a noise jamming capability from the HF spectrum through I and J-bands, the overall doctrine of the Communist world is based on a belief in the superiority of deception methods over overt jamming. They have expended a great deal of effort in gathering the information and producing the equipment necessary for utilization of deception techniques. A truly

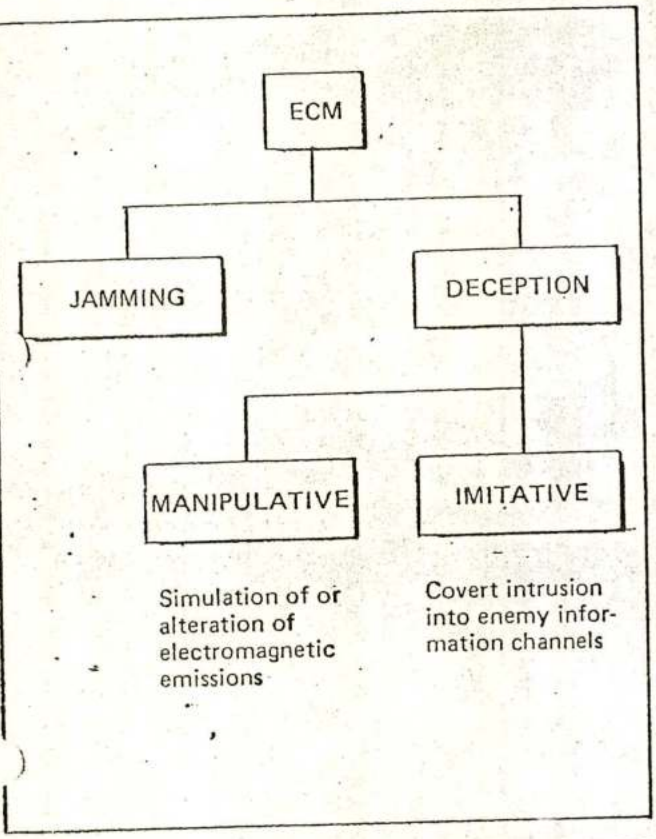


Figure 6-1. (U) Functional Relationships of DECM

successful enemy effort may go completely undetected, but most attempts at deception in this area can be detected and reported by an alert operator. All MIJI incidents should be reported completely in a timely manner. OPNAVINST C3430.18/MCO 03430.3 series includes a standardized reporting format and procedure to be used by all units in reporting MIJI incidents. Since the general term MIJI covers a variety of operations, they will be discussed one by one.

6.2.1.1 (C) Meaconing. This term describes enemy employment of electronic devices which produce false information to lead aircraft and ships off their desired tracks. These devices masquerade as friendly navigation systems and homing beacons that falsely identify themselves and give misleading directional/distance information. On occasion, the entire range of electronic navigation aids (LF/MF radio ranges and beacons, tacan, loran, and so forth) have been subject to meaconing.

6.2.1.2 (C) Intrusion. Intrusion is an attempt by the enemy to enter into and be accepted by communications nets of U.S. forces and their allies. Being accepted by operators of the net is the key to successful intrusion. Intrusion attempts are usually directed against low-level communications channels. The purpose of the intrusion is to gain intelligence of immediate tactical value and to introduce confusion. Intrusions are generally attempted by linguists trained in the operations and terms used in military communication nets. The linguists masquerade as legitimate net operators and try to obtain details of flight plans of aircraft, timing and routes of surface operations, and call sign information. A completely successful instruction effort may not be recognized as such. Intrusion is most likely on clear voice transmission links. The simple equipment required, the wide usage of English language terms in communication procedures, and the simple identification procedures all favor intrusion tactics. Intrusion attempts can usually be thwarted if all operators in a communication net insist that authentication procedures be rigidly followed. Successful intrusion into covered voice or teletype systems is much more difficult, but cannot be ruled out entirely. These systems are much more likely to be subjected to jamming or intentional interference. In using simple codes it must be remembered that they may be saturated in less than a 24-hour period. Under these conditions the enemy can produce a reasonable facsimile of the codes being used on a particular day.

6.2.1.3 (C) Jamming. In recent years the Soviets have relaxed their restrictions on jamming of U.S. electronic equipments and many more cases of deliberate jamming have been reported. Whereas some of these attempts have been very obvious and easily detected, there have been isolated instances of deceptive jamming which were not readily detectable. Radar jammers may affect voice circuits in a way which produces the effect of gross signal distortion due to equipment malfunction rather than intentional jamming.

6.2.1.4 (C) Interference. In contrast to meaconing, intrusion, and jamming, interference is usually caused by another authorized emitter on the same frequency. Interference is more common on communications circuits than on noncommunication frequencies such as radar or IFF channels.

Interference may be generated by on-board emitters, or in the HF spectrum by emitters thousands of miles away. Ducting may cause interference between widely separated emitters which normally experience no interference. Willful and deliberate interference is classified as jamming, and is reported as such.

CHAPTER 7

ECM Equipment Design Principles

7.1 (C) PURPOSE

(C) ECM equipment and deception devices consist of electromagnetic energy radiators, re-radiators, signal absorption materials, and reflective devices. They are employed to nullify the usefulness of enemy electronic equipment by jamming to deny him receipt of information or by deception to provide him with false information.

(C) This chapter covers basic design principles. Although specific equipment is available to ECM, only the imagination and ingenuity of the individual limits the possible use of any electronic radiator or reflection device for ECM.

7.2 (C) COMMUNICATIONS COUNTERMEASURES EQUIPMENT

(C) Equipment used for communications countermeasures may be of special design; however, standard communications equipment may be employed, provided suitable modulation is used to jam the particular type of system in use. The following paragraphs describe the more common types of ECM equipment modulation.

7.2.1 (C) Noise. The carrier is modulated by a series of voltage fluctuations having random amplitude and frequency. Common noise generators used for this purpose supply random signals in the frequency range from a few Hz to about 1,500 Hz.

7.2.2 (C) Saw. The carrier is modulated by an audio-frequency voltage wave form which varies in frequency. At any particular time the frequency varies over a fixed range; for example, from 0 to 500 Hz or from 500 to 1,500 Hz with the variation cycle generally taking place about once or twice per second, thus producing a distinctive warble.

7.2.3 (C) Random Saw is similar to saw modulation except that the frequency of the random saw varies in discontinuous jumps as compared with the steady frequency change of saw.

7.2.4 (C) Random Keying. The carrier is modulated by a series of pulses which are negative or positive, depending on the type of equipment being used. The rate at which these pulses occur is variable to simulate keying speeds from a few words per minute to about 30 to 40 words per minute.

7.2.5 (C) Bagpipes. The carrier is modulated by several sinusoidal audio tones in rapid sequence. This method is extremely effective against voice circuits.

7.2.6 (C) Square Wave Modulation. The jamming carrier is square wave modulated at a slow rate (2-10 Hz). Superimposed on the square wave is frequency modulation (FM) in the 400 to 1,000 cycle range and amplitude modulation (AM) up to 100% of the FM products. This technique is effective against voice transmissions and achieves very high effectivity when the jamming carrier is tuned to within a few hundred Hz of the victim carrier. Accurate tuning of the jamming carrier reduces jamming power requirements to achieve effectiveness since the jamming carrier and modulation products beat directly with the victim carrier and create modulation products within the voice fundamental frequency range (400-1,000 cycles).

7.2.7 (C) Direct Amplified Noise (DINA) without a carrier frequency may be used for the purpose of saturating a radio receiver with noise. This jamming technique is also called GAUSSIAN or WHITE NOISE. DINA is also effective against radars.

7.3 (C) ELECTRONIC JAMMING EQUIPMENT

(C) Electronic jamming equipment produces random noise or signal-like emissions for the purpose of interfering with enemy sensors. Jammers capable of obscuring information are referred to as "masking jammers" as opposed to repeaters which create false information and transponders which enhance echo return.

(C) The use of masking jammers results in "snow," "strobing," and gain noise spikes on the radarscope. In some radars which employ automatic gain control (AGC) or automatic noise limiting (ANL), a blanking out of the scope may occur. Power, bandwidth, and type of modulation available are of prime consideration in the selection of a jammer.

(C) The complexity required in masking jammers depends greatly on the radar to be countered. For example, if the victim radar has frequency diversity, associated receivers and programmers may be required to maintain the jammer on the correct frequency. ECCM circuits in modern radar receivers have required new and complex types of modulation to be incorporated into masking jammers. As radars become more sophisticated, so must the jammer; and thus begins the endless cycle of ESM, ECM, and ECCM.

7.3.1 (C) Basic Types. The four basic techniques of electronic jamming are:

1. Spot
2. Sweep
3. Frequency search and lock
4. Barrage.

These are employed for either self-screening or stand-off jamming.

7.3.1.1 (C) Spot Jammers are narrow band, manually tunable transmitters which may be modulated in frequency or amplitude by random noise or by a periodic signal. They are employed on a one jammer versus one radar basis and must be manually set on the victim radar frequency. Panoramic intercept receivers must be used with spot jammers to set the transmitter frequency of the victim radar. For jamming to be effective, the transmitter must normally be tuned to within the bandpass of the victim radar. Once the jammer has been set on frequency, the operator is "blinded" on that frequency by his own jammer.

7.3.1.1.1 (C) Look Through. For the operator to detect his jammer drifting off frequency or to detect a shift in frequency by radar with frequency agility, he must possess a "look through" capability. Look through is the capability to monitor the victim radar through the jamming signal. One way of achieving look through is to manually turn the jammer off periodically. While this may be effective against a fixed frequency radar, many observations of a short duration would be required if the radar employed frequency agility. Alternate methods are to automatically turn the jammer off for a few milliseconds each second or to use a correlator in conjunction with the intercept receiver to prevent the jamming signal from entering the receiver.

7.3.1.1.2 (C) Advantages and Disadvantages. The salient advantage of spot jammers is an output concentrated in a very narrow frequency spectrum. Hence, a greater power per MegaHertz rating (watts/MHz) can be achieved than with barrage jammers of the same size and weight. This is a very important consideration in airborne ECM equipment.

(C) Disadvantages of the spot jammer are as follows:

1. Can be employed against only a narrow band of frequencies at one time
2. Requires a passive receiver to initially set the transmitter on frequency
3. Requires constant monitoring by an operator
4. Effectiveness is easily degraded by a radar possessing frequency agility
5. Requires a high degree of skill on the part of the operator because of accuracy required in tuning.

7.3.1.2 (C) Sweep Jammers are narrow band, automatically tunable transmitters that sweep back and forth through a frequency band at a predetermined rate. The frequency may be tuned either mechanical or electronically from a few sweeps per second to several thousand sweeps per second. The same types of modulation may be employed as in the spot jammer. Sweep jammers may also double as spot jammers. The primary difference between the two is in the automatic tuning circuit.

(C) Sweep jamming combines the advantage of concentrating power in a narrow band and covering multiple targets at the expense of reduced jamming effectiveness unless the receivers being jammed have poor recovery characteristics. In this case a condition referred to as "ringing" occurs in the victim receiver(s). The presence of a jamming signal as it sweeps through the receiver causes oscillations in the receiver which continue to present jamming on the scope. The oscillation will slowly die out, but by that time the jammer will sweep through again and repeat the process. Sweep jamming can be very effective against unsophisticated radars where the oscillations die out slowly.

7.3.1.3 (C Frequency Search and Lock Jammers use a transmitter in which a narrow band jamming signal can be tuned over a broad frequency band and the signal locked on a particular frequency. This is essentially a spot jammer with the additional feature of an automatic lock-on capability. The jammer receiver determines the frequency and tunes the spot jammer to this frequency. By providing a look through capability, the receiver can be made to start sweeping again when the original signal being jammed disappears. This system may also be programmed to time share the jammer between different emitters on a sequential basis. Thus, a frequency search and lock jammer will pause for a predetermined time on each programmed signal encountered.

(C) The advantage of the frequency search and lock jammer is its speed in detecting and jamming a threat signal. It concentrates power into a narrow band and can be used to follow a frequency shifting radar.

(C) The jammer lacks the ability to recognize and adjust to changing situations and must be programmed in advance based on known characteristics of the threat. Pre-trigger blanking of frequency search and lock jammers should be employed when own unit's emitters are operating which have basic or harmonic frequencies lying within the searched spectrum.

7.3.1.4 (C) Barrage Jammers are wide band noise transmitters or frequency modulated transmitters which deny the use of frequencies over a wide portion of the electromagnetic spectrum. The jamming bandwidth is normally variable and in some equipment may be divided between two or more portions of the spectrum.

(C) One of the most effective types of barrage jammers is the wide band noise transmitter which does not contain any one carrier frequency. Maximum power is contained in the noise. If the jamming or noise density is constant throughout the jamming bandwidth, the noise is referred to as "white noise." White noise implies that the jamming is fairly constant throughout the jamming bandwidth.

(C) In addition to white noise transmitters, a wide band jamming signal may be produced by frequency modulating with noise or a periodic signal. If the modulation is noise, the output frequency is randomly distributed throughout the band. The desired result of frequency modulation with wide band or low frequency noise jamming approximates white noise. In reality, "peaks (high power output areas) and "valleys" (low power output areas) appear at random in the spectrum. This allows the victim radar (if it can tune in frequency) to seek out the valley and tune to areas of minimum jamming.

(C The primary advantage of a barrage jammer is its ability to jam multiple radars and to cover the entire range of radars capabable of frequency diversity or agility. On the adverse side, the most salient feature of broad band jammers is the low power per MegaHertz available. Other disadvantages include the dead spots in the spectrum mentioned earlier and the fact that the jammer frequency band may have to be preset by maintenance personnel. Another limiting factor is the inability to jam enemy radar operating near the frequency of a friendly radar without jamming the friendly radar. Restrictions imposed by the commander may also prohibit the use of barrage jammers because of their inability to perform selective jamming.

7.3.2 (U) Modulation and Antenna Efficiency

7.3.2.1 (U) Modulation. The effectiveness of jamming equipment is determined not only by how much power is available and how it is distributed in frequency, but also by how the power is distributed in time. A modulated signal is one which varies in frequency or amplitude (power output) according to some predetermined function. The basic types of modulation are frequency (FM) and amplitude (AM). Continuous wave jamming is referred to as CW. This type of jamming originally implied only that the jamming was continuous as opposed to pulse and carried no connotation as to modulation. CW is still used in this sense when referring to radar output. However, through usage, CW has also come to mean carrier wave jamming indicating that the jammer is unmodulated.

Numerous methods of modulating the frequency, amplitude, and on/off times of the transmitter have been devised. The jamming signal may be modulated with:

1. Gaussian noise (white noise, DINA)
2. Wide band noise
3. Low frequency noise
4. Low frequency sine waves
5. High frequency sine waves plus noise
6. Sawthooth waves, including bagpipes, and so forth
7. FM noise with audible clicks.

There is a multitude of possible combinations, and the relative merits of one over the other depend greatly on the victim radar receiver and the ECCM features it contains.

Noise is the most common method of modulation employed and consists of random variation of frequency and/or amplitude of the jamming signal. It is considered the most effective and the most difficult to counter because of its random nature.

7.3.2.2 (U) Antenna Efficiency is vital to the overall effectiveness of the jammer. Important considerations include the antenna:

1. Gain
2. Beam width
3. Polarity
4. Matching
5. Location.

Antenna gain and beam width are measures of the antenna's ability to concentrate power in a particular direction through the focusing action of the system. The decibel (db) is used to measure this ability. An isotropic antenna (one which radiates equally in all directions) is assigned a value of zero db. A directional antenna (one which focuses power in particular direction) has a power gain in that direction expressed in db. Each 3 db gain indicates that the directional antenna delivers approximately twice as much power in that direction as an isotropic antenna. Thus, a 3 db antenna would deliver twice the power of a zero db antenna, and a 6 db antenna would deliver twice the power of a 3 db antenna or 4 times the power of a zero db antenna.

In an antenna whose radiation patterns are characterized by a single beam (or at least a beam which is large in comparison with any side lobes), the directive gain can be calculated approximately from the half power beam widths in two orthogonal planes through the beam maximum. The directive gain with respect to an isotropic source is:

$$\frac{41{,}000 \times 0.75}{W_1 \times W_2}$$

where

41,000 = constant (square degrees in a sphere)
W_1 = beam width in degrees in one plane
W_2 = beam width in degrees in the other plane
0.75 = allowance for aperture efficiency.

The result of this calculation is a figure that may be verted to db by assuming that 1=0 db, 2=3 db, d with each doubling of the basic number, an reasing of 3 db is realized (see Figure 7-1). An tenna with a vertical beam width of 20 degrees and horizontal beam width of 5 degrees will result in a se number of 308 From Figure 7-1 it may be termined that this antenna has a gain of proximately 25 db.

Although increasing antenna gain is an advantage the sense that it increases the effective power tput,it may also prove to be a limitation in that it quires a particular orientation of the jamming hicle relative to the target. Therefore, the tactics to used are a primary consideration in determining e most effective antenna in any given situation.

DIRECTIVE GAIN	CORRESPONDING DB
1	0
2	3
4	6
8	9
10	10
16	12
32	15
64	18
100	20
128	21
256	24
512	27
1,000	30
2,048	33
4,096	36
8,192	39
10,000	40
16,384	42
32,768	45
65,537	48
100,000	50

NOTE: Table may be continued to any value by doubling the base figure to produce 3 additional db. Figures in this table are approximate except for powers of 10.

Figure 7-1. (U) Directive Gain Converted to Decibels

The antenna must be matched to the system. Otherwise, a majority of the power will be dissipated in the radiation system or reflected back to the transmitter. The voltage standing wave ratio (VSWR) is used to measure the match of the antenna. A VSWR of 1.0 indicates a perfect match and that all the power is radiated. A VSWR greater than one indicates that part of the power is being reflected back into the transmitter. Although an optimum VSWR of 1.0 is desired, practical values range from a 1.2 to 1.6 and even greater in lower frequency equipment.

7.5 (C) NONELECTRONIC DEVICES

(C) Nonelectronic devices present false targets to the victim radar. They may be considered as jamming or deception devices, depending on their intended purposes. Devices of this type include chaff, rope, and decoys.

(C) NAVORD OP 3840 should be checked to ensure that neither intraship interference nor intership interference with own task force ships occurs.

7.5.1 (C) Chaff is the name used for resonant dipoles, usually lightweight strips of foil or metalized plastic or fiberglass dropped from aircraft or dispersed from bursting shells or rockets. Each chaff strip acts as a reflector to return an echo to enemy radar equipment. The ideal chaff strip length is 0.475 times the wavelength of the victim radar frequency.

(C) The reflecting capability of chaff is based on the principle of electromagnetic resonance. The strength of echoes produced depends largely on the accuracy with which reflectors are cut (or tuned) to the frequency of the enemy equipment. Normally, the chaff strips affect all radars operating within 5 to 20 percent of the frequency to which they are cut. They are particularly effective in jamming radars which have low resolution (limited ability to distinguish between two or more targets in the same area).

(C) When chaff is dispensed in an area, it returns a clutter of echoes which may either completely obscure the target echoes or may produce false echoes. A confusion of echoes on enemy surveillance radar reduces his capability to detect, track, and make altitude measurements. In the case of tracking radars chaff can sometimes break the lock-on.

7.5.1.1 (C) Principal Uses of chaff are to:

1. Provide concealment

2. Provide break-lock deception of tracking radars

3. Present false surface/airborne targets.

7.5.1.2 (C) Advantages of chaff are:

1. Ability to produce echoes over a large part of the spectrum with small amounts of material

2. Ability to present clutter or interference to confuse or delay target acquisition by enemy radar

3. Wide bandwidth response which is prohibitive in electronic designs

4. Comparatively low cost

5. It is not subject to saturation by large signal densities or to degradation at short "radar-to-target" ranges that is often encountered with electronic jammers.

7.5.1.3 (C) Disadvantages of chaff are:

1. Susceptibility to meteorological environment

2. Relatively short time that solid target persistence is obtained

3. Ineffectiveness against pulse doppler radars

4. Possiblity of interference with friendly radars.

7.5.1.4 (C) Specification of chaff relative to frequency coverage, types, and related equipment may be found in the Air Force Electronic Warfare ECM Directory.

7.5.1.5 (C) Precautions. Caution must be exercised by jet aircraft operating in areas where chaff is or has been dropped since ingestion of that material into an engine can result in serious damage.

(C) Resonant dipoles currently in use can vary in length from less than an inch to over 75 inches. Longer types of chaff (that is, 9 inches and longer) falling on or near electrical power or transmission lines can possibly cause damage resulting from short circuits. Therefore, it is imperative that chaff movement and fallout prediction be as accurate as possible to preclude interference with commercial electrical facilities. Regulations regarding the use of chaff should be reviewed periodically and followed meticulously.

7.5.2 (C) Rope consists of ribbons of metallic foil or coated fiberglass string varying in length from approximately 50 feet to over 700 feet designed to provide broad band coverage in lower frequency bands (for example, A, B, and C bands). As it falls, twists, and turns, it presents various aspects to the victim radar, some of which return strong echoes. It is not uncommon to have both chaff and rope in the same package, thus providing response over a broad band of frequencies. The precautions noted in paragraph 7.5.1.5 for conventional chaff apply to even a greater degree to rope.

7.5.3 (C) Decoys are devices used to present false air and surface targets or to cause a small target to produce a large echo, thus creating difficulty in evaluating the threat. Devices commonly employed as decoys include:

1. Corner reflectors
2. Gulls
3. Kites
4. Individual chaff bursts.

7.7 (C) FUZE COUNTERMEASURES

7.7.1 (C) Fuze Countermeasures Equipment. Radio proximity fuzes are used in a variety of artillery shells and missiles. This type of fuze requires only that the shell or the missile come close to the target. A direct hit is not required for detonation. The fuze contains a transmitter and receiver. Its detonation will depend on range from the target and orientation to the target. If a doppler type fuze is used, it will detonate near the closest point of approach to the target. At this point the doppler shift is near zero, indicating the closest point of approach of the shell or missile to the target.

(C) Countermeasures equipment may consist of spot or barrage jammers, repeaters, or transponders. The principle is to present the shell or missile with a false target echo, causing it to detonate prior to coming within lethal range of its target. Spot and barrage jammers can be used effectively if the frequency of the fuze is known in advance and passive detection is not required. Repeaters and transponders are well suited to fuze countermeasures and have been used effectively against specific fuzes.

(C) Noticeable shortcomings of fuze countermeasures equipment are:

1. The countermeasures must be located on or in close proximity to the target vehicle

2. The lack of universality of the equipment.

A transponder or repeater design may be based on specific expected properties of enemy fuzes. Thus, the merit of such equipment depends on the economy of equipping the target with sufficient devices to counter all possible threats.

7.7.2 (C) Navigation and Identification Countermeasures Equipment

7.7.2.1 (C) Navigation Countermeasures Equipment. No specific equipment is used to conduct navigation countermeasures. Equipment designed for other countermeasures is used for this purpose.

7.7.2.2 (C) Identification Countermeasures Equipment. This equipment would be designed to duplicate the responses of enemy identification equipment and would normally be of the transponder type. Technical details such as interrogation frequencies, transponder frequencies, and transponder reply coding are necessary so that equipment may be designed to respond to a challenge

by the enemy. Such response may lead him to believe that the reply is from a friendly unit or at least delay evaluation of the actual threat involved.

CHAPTER 8

Electronic Counter-countermeasures

8.1 (U) DEFINITION

(U) Electronic counter-countermeasures (ECCM) is that division of EW involving actions taken to ensure friendly effective use of the electromagnetic spectrum despite the enemy's use of EW. Figure 8-1 shows the functional relations of ECCM.

8.2 (C) EMPLOYMENT

(C) ECCM optimize the electromagnetic capabilities of own forces by negating the effectiveness of enemy EW actions. This is accomplished by employment of:

1. Emission control (EMCON)
2. Tactical evasion
3. Antijamming circuits
4. Frequency diversity
5. Frequency Agility
6. Operator technique.

(C) Naval operations frequently take place over extended periods and in limited geographic areas where an enemy has ample opportunity to employ his EW capability. Any potential enemy can be expected to possess the technical ability to use EW measures equivalent to our own. Consequently, the U.S. forces must maintain effective control of own electromagnetic emissions and thereby reduce the success of enemy ESM. When ECM is used against U.S. forces, it is equally important that such action be detected and that adequate countermeasures be applied. To achieve and maintain an effective ECCM capability requires planning and training. Because enemy ECM may interfere with communications, ECCM plans should include consideration of alternate means of communications, such as beamed super high frequency transmission, laser, infrared, wire, visual, telephone, or messenger, which will ensure coordination of ECCM action. Knowledge of enemy capabilities must be as complete as possible in order to direct own force reaction and to develop successful ECCM innovations.

8.3 (C) ANTI-ESM

8.3.1 (C) Emission Control (EMCON) includes control of:

1. All electromagnetic radiations
2. All electroacoustic radiations
3. All electro-optical emissions.

The principle of EMCON is that only the equipment necessary to accomplish the mission will be allowed to radiate. This reduces the intelligence available to the enemy and improves own force ESM intercept capability by reducing ambient radiations. Frequency diversity is employed to minimize mutual interference. Effective control must be exercised when employing jamming equipment and deception devices to avoid mutual interference among own force equipment. EMCON is a vital factor in conducting successful EW. Because of the extreme importance to naval forces of adopting and maintaining effective EMCON procedures, a detailed presentation of EMCON is provided in Chapter 9.

8.3.2 (C) Tactical Evasion of enemy ESM can be an effective counter-countermeasure. Total emission silence (to avoid detection) may not be required if the force remains out of detection range or uses screening

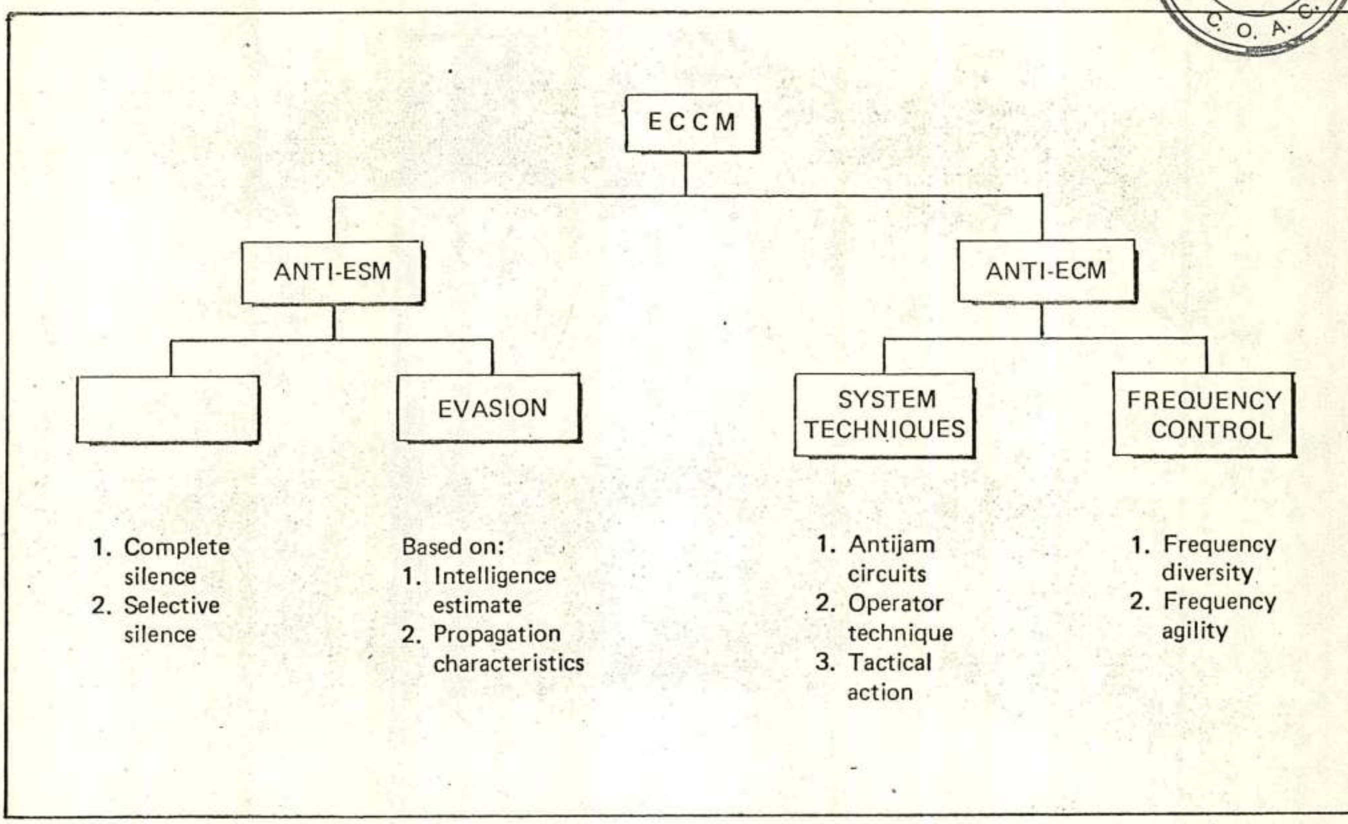


Figure 8-1. (U) Functional Relationships of Electronic Counter-countermeasures

features of terrain. Planning considerations must include:

1. Intelligence estimations of enemy intercept equipment capabilities

2. Ambient propagation characteristics

3. Topographical features (radar shadow)

4. Tactical requirements of the force.

Although accurate calculation of intercept probabilities may be difficult, tactical advantages in operating force electronic equipment should be weighed against risk of dtection.

8.4 (C) ANTI-ECM

(C) Antijamming techniques rely on technical design of equipment and operator proficiency to counter enemy use of ECM.

8.4.1 (C) Basic Antijam Circuits

8.4.1.1 (C) Automatic Video Noise Limiting (AVNL). The AVNL circuit prevents received signals of excessive amplitude from blocking the video amplifier in the units to which the output of the circuit is applied. This is accomplished by automatically adjusting receiver gain after each range sweep so that a fixed noise level is maintained. Thus, if noise jamming is received on one bearing, the receiver gain will be reduced on that bearing.

8.4.1.2 (C) Beam-to-Beam Correlation (BBC). Some phased array radars employ this technique as a means for rejecting nonsynchronous interference pulses, including jamming at a swept frequency. For a single target to be detected, its signal must exceed a threshold voltage within two overlapping beams.

8.4.1.3 (C) Coverage Contour is another type of JAVA display (see paragraph 8.4.1.8) in which the effective range of radar coverage is displayed as well

as the bearing of the jammer. When jamming is present, a range ring is displayed on the PPI scope at the appropriate range at which jamming signals exceed the signal strength of the target returns. Target returns are presented only inside the ring. The direction of the jammer is indicated in this display by a displacement of the ring on the appropriate bearing.

8.4.1.4 (C) Detector Balanced Bias (DBB) discriminates against returns of large range extent and is similar to FTC in effect although different circuitry is employed.

8.4.1.5 (C) Dicke Fix. The Dicke Fix is an ECCM device which counters some kinds of pulse, swept frequency, and noise jamming. These types of jamming induce circuit oscillations or ringing which obscure signals in the receiver if it dies down slowly and/or is started frequently. In the wide band limiting amplifier of the Dicke Fix, the oscillations die out quickly because of the lower Q of the wide band amplifier, and the amplitude of the originating disturbance is reduced by the limiting action. The wide band limiting amplifier is followed by a narrow band amplifier, which is matched to the radar pulse width.

(C) Dicke Fix should be used with caution since narrow band noise or CW which is within the wide bandwidth (but outside the narrow bandwidth) will capture the limiter and suppress signals at the radar frequency. The loss of targets may go unnoticed by an operator unless there is a ring generator or some other indicator of sensitivity as a function of azimuth.

8.4.1.6 (C) Fast Time Constant (FTC). The FTC circuit reduces the blanking effect of long-duration signals. When the FTC circuit is in operation, normal target presentations on the scope are reduced to smaller, better defined targets. Ground clutter, some types of transmission jamming (particularly wide pulse jamming), and reflected jamming caused by large chaff drops return a high amplitude, wide pulse echo. If a target echo exists within the large jamming pulse, it may be obscured.

(C) The use of FTC may break up the jamming pulse and permit the target echo to be seen if it is of greater amplitude than the jamming signal. The operator must realize that target echoes will be distorted and weak target echoes may be lost.

8.4.1.7 (C) Instantaneous Automatic Gain Control. (IAGC) is a fast (on the order of a pulse length) response AGC which acts to inhibit large signals of long duration. Changes in signal level which are as fast, like a real pulse, will pass and be displayed, but slower fluctuating jamming will be reduced. IAGC is more effective against fluctuating jamming than AVNL, which samples the jamming only at the end of a sweep. IAGC may recover targets which would otherwise be lost by saturation, and it reduces the large bright areas of jamming.

8.4.1.8 (C) Jammer Amplitude Versus Azimuth (JAVA). The JAVA system determines the azimuth and relative power of a jammer. Noise amplitude is presented as a function of bearing on the PPI scope. In the absence of jamming, the presentation consists of ambient noise deflection creating a ragged circle much like a range ring. When a jamming signal exists, the noise level at the appropriate bearing will be increased, causing greater noise ring deflection at that bearing. The display in the presence of jamming will have a lobe extending in the direction of the jamming in an amount proportional to the jamming signal strength.

8.4.1.9 (C) Jammer Amplitude Versus Elevation (JAVE). JAVE is a system used to determine the elevation and relative power of a jammer. It employs the same principles and type of displays as JAVA.

8.4.1.10 (C) Linear-Logarithmic Amplifier (LIN-LOG). The LIN-LOG is a receiver which provides linear amplification of weak signals but provides logarithmic amplification of high amplitude input signals. This technique provides all of the advantage of a logarithmic receiver while providing improved amplification of weak input signals. Commonly, LIN-LOG and LOG receivers are grouped together as LOG receivers.

(C) Logarithmic receivers act to prevent saturation effects and are like a truly instantaneous AGC. Since small increases such as a signal on top of jamming are not especially enhanced by the logarithmic response, it is customary to follow the log receiver with FTC.

8.4.1.11 (C) Moving Target Indicators (MTI). MTIs are used to detect moving targets in the presence of ground clutter, chaff and other nonmoving targets. The common MTI schemes depend on pulse-to-pulse cancellation of fixed targets using the doppler effect on frequency resulting from a radial component of velocity or lack thereof. The two basic MTI systems are the coherent and noncoherent systems.

(C) In the coherent MTI system, returned signals are compared in phase with an internally generated reference signal of the exact frequency and in fixed phase relation with the transmitted pulses. Returns from moving targets vary in phase with the reference while returns from fixed targets will have the same phase relative to the reference. By storing and subtracting successive pulses, the fixed target returns will be canceled while the moving target returns will not, except at the blind speeds where the speeds and frequencies (RF & PRF) are such that the phase changes by 360° between pulses.

(C) In the noncoherent MTI system, the reference signal is the return from nearby chaff or clutter. The phase comparison is made in space as the two signals arrive at the antenna. There is a disadvantage in that with no clutter, moving and fixed targets cancel out. Thus, gated MTI or intermittent use appears desirable for noncoherent MTI.

(C) Gated MTI permits the use of MTI in only that region where it is desired. Many variations of gated MTI exist, including manual range-gated MTI, sector-gated MTI, and automatically gated MTI. Range-gated and sector-gated MTI permit the operator to select the range of azimuthal limits within which the MTI circuitry is activated. An automatically gated (clutter-gated) MTI system activates the MTI circuitry automatically when a receiver signal exceeds a pre-set time duration value. Clutter-gated MTI is most valuable in the case of noncoherent MTI systems since these systems, when their circuitry is activated, reject moving target returns when the targets are free of clutter.

(C) Moving Platform MTI (AMTI). (This technique is also called Airborne MTI.) Compensation for platform motion is achieved by an additional doppler frequency oscillator, which is adjustable and, in fact, must be changed with rotation of the antenna since clutter abeam will have zero velocity.

8.4.1.12 (C) Pulse Amplitude Discrimination (PAD). The PAD video processing circuit rejects all pulses that have a larger amplitude than the expected target echo amplitude. It prevents excessive amplitude jamming signals from being displayed but does not allow subjamming visibility.

8.4.1.13 (C) Polarization Cancellation (PC) is an antijam feature which accepts only those electromagnetic radiations which are polarized in the same direction as the transmitted pulse. It is a characteristic of most radar receivers that signals of undesired polarization will be detected, although attenuated to a certain extent. However, the PC feature rejects completely any signals of undesired polarization.

8.4.1.14 (C) Pulse Compression/Expansion (P-COM/EXP) is a pulse coding system which permits recognition of echoes by the receiver. This technique employs the stretching of the transmitted pulse to a desired length and then the compressing of the received echo. Matched filters code and decode the pulses. These filters discriminate against jamming signals since the jamming signals do not correspond to the coding pulse being used by the transmitter.

8.4.1.15 (C) Pulse Edge Tracking is a technique employed in fire control circuits to prevent capture of tracking circuits by chaff. The edge tracked depends on the target aspect and will be the edge opposite to the end from which the chaff is emanating.

8.4.1.16 (C) Pulse Width Discrimination (PWD). The PWD video processing circuit rejects all pulses wider or narrower than the transmitted pulse. A delay line cancellation technique is used to discriminate against pulses of undesirable width. The delay line output is applied to a pulse stretcher to return the accepted signals to the proper width. Wide band amplifiers are used with this circuit to minimize the width distortion inherent in narrow band amplifiers.

8.4.1.17 (C) Range Rate Memory. The range rate memory circuit is used in conjunction with tracking circuits to reject spurious targets which differ from the desired target in range rate. Video amplitude limiting

is employed to prevent deterioration of the range rate memory storage by signals of excessive amplitude from chaff or jamming.

8.4.1.18 (C) Sensitivity Time Control (STC). The STC circuit reduces the effects of ground clutter and high amplitude echoes from nearby targets. It lowers the receiver gain immediately following the transmitter pulse and then increases it gradually as the range increases. STC is used primarily to reduce the blossoming effects from strong nearby signals. It is an anticlutter device and has only limited ECCM applications.

8.4.1.19 (C) Side Lobe Suppression (SLS) eliminates signals which enter the antenna system through the side lobes of the antenna pattern. Like SLB, it employs a separate omnidirectional antenna and cancellation receiver; however, SLS uses a filter system rather than a blanking gate. SLS reduces radar sensitivity but allows display of signals entering through the main lobe while jamming signals are being received through the side lobes. SLS can be used in a continuous jamming environment.

8.4.1.20 (C) Side Lobe Blanking (SLB). The SLB system eliminates signals that enter the antenna system through the side lobes of the antenna pattern. It employs a separate omnidirectional antenna and cancellation receiver. The gain of the cancellation receiver is set so that the output of the main receiver is greater than that of the cancellation receiver for targets in the main lobe but less than that of the cancellation receiver for targets in any side lobe. An interfering signal entering the main antenna and receiver is also picked up by the omnidirectional antenna and cancellation receiver.

(C) Signals which have entered through the main lobe are displayed on the radarscope since the output of the main receiver is greater. However, if the signal was received through a side lobe, the output of the cancellation receiver will be greater, causing a blanking gate to open, preventing display of the signal on the radarscope. Signals entering through the main lobe cannot be presented on the radarscope while the blanking gate is open. SLB should not be used against strong, continuous side lobe jamming as all video will be lost. SLB is effective for eliminating false side lobe targets or intermittent side lobe jamming.

8.4.1.21 (C) Single Beam Blanking (SBB). Owing to the nature of some phased array radars, the target signal will appear in more than one beam because of overlapping beam widths as the beams are scanned past a target. That noise which only appears in one beam will be blanked and not painted.

8.4.1.22 (C) Variable Pulse Recurrence Frequency (PRF Jitter) is a technique which eliminates interference from adjacent radars or synchronized pulse jammers or spoofers. In this technique, the PRF of the transmitter is varied in random fashion from pulse to pulse so that other transmitters or jammers cannot synchronize with it. The unsynchronization of the jammer removes the spatial coherence of the false generated echoes so that they vary in range and becomes less distinct.

8.4.1.23 (C) Video Integration (VI) is a technique which eliminates random echoes from the radarscope display. It involves the addition of the video from one sweep to that of successive sweeps. The process depends on the fact that true targets have the same time relationship from sweep to sweep and that most types of jamming and interference do not. The video integrator clips all input signals at a low level so that noise, interference, and echo signals all have the same sample amplitude. Each sweep is then delayed and added to successive sweeps until some predetermined level has been reached. Because of the spatial coherence of target echoes, those signals build as the sweeps are added, while the incoherent noise and interference remain at a low level. This circuit provides excellent protection against nonsynchronized jamming and interference.

8.4.2 (C) System Techniques. Antijam circuits can be grouped into the following general categories based on the method used to counter the effects of jamming or deception.

8.4.2.1 (C) Circuits Which Present Strong Jamming Signals From Overloading or Saturating the Radar Receiver and Thereby Blanking or Obscuring Real Target Echoes. Some circuits of this type are:

1. Logarithmic amplifiers

2. Automatic video noise leveling

3. Sensitivity time control

4. Automatic gain control

5. Dicke Fix.

8.4.2.2 (C) Circuits Which Prevent Jamming Signals From Passing Through the ECCM Circuit While Permitting Target Echoes to Pass. These circuits discriminate between the jamming signals and target returns by comparing the signals in one of the following ways:

8.4.2.2.1 (C) Pulse Characteristics. Signals which have a longer or shorter duration or excessive amplitude compared to the target signal are canceled. Circuits employing this technique are:

1. Fast time constant

2. Pulse compression

3. Pulse width discrimination

4. Pulse amplitude discrimination.

8.4.2.2.2 (C) Direction of Arrival. Signals which arrive from a direction other than the direction of the main radar lobe are not displayed. Examples of application of this technique are side lobe blanking and side lobe suppression.

8.4.2.2.3 (C) Polarization. Signals which do not have the proper electronic polarization are canceled. An example of this technique is polarization cancellation.

8.4.2.2.4 (C) Speed Characteristics. Signals which have not changed position from sweep to sweep are eliminated. Examples of this technique are moving target indicators.

8.4.2.2.5 (C) Repetition Period. Signals which do not repeat at the same interval from pulse to pulse are eliminated. Examples of application of this technique are video integration and PRF jitter.

8.4.2.3 (C) Circuits Which Indicate Direction of Jamming Source and Relative Intensity of Jamming. Examples of this technique are:

1. Jammer amplitude versus azimuth

2. Jammer amplitude versus elevation

3. Coverage contour

4. Signal strength generator.

8.4.2.4 (C) Tracking Circuits Which "Remember" Target Rate of Motion in a Given Direction to Preclude Decoying the Tracking Radar to False Targets. This technique is employed by range rate memory circuits and angle coast circuits.

8.4.3 (C) Frequency Diversity. The purpose of frequency diversity is to establish an electronic system which imposes unacceptable space and weight penalties on the jammer. It is the spreading of frequencies for each type of equipment to the greatest possible extent throughout the electromagnetic spectrum. This requires that the enemy spread his jamming effort in direct proportion in order to jam all equipment of a given type. If the enemy does not spread his jamming effort, selected own force equipment will remain effective. If he does spread his effort, the jamming power on any given frequency is reduced. Frequency diversity is a useful technique, both to degrade an enemy jamming capability and to minimize mutual interference among the radiating equipment of own force.

8.4.4 (C) Frequency Agility. Frequency agility is a technique employed within a given electronic equipment in which the frequency of the transmitter is automatically varied over a specific frequency range. This reduces the enemy's ability to jam the given electronic equipment. However, because of the broader spectrum usage by each equipment, mutual interference tends to increase.

8.4.5 (C) Operating Techniques and Procedures

8.4.5.1 (C) Operator Training is the most important aspect of ECCM preparedness. Depending upon the particular configuration, the equipment operator may not have control of the ECCM features of the equipment. This is usually the case where multiple repeater displays are utilized. It is important that some individual be responsible for exercising the

ECCM features of any system. This ECCM operator may be the equipment (for example, radar) operator or other individual specifically assigned. It is recommended that ECCM operators participate in live ECM exercises whenever possible. Operators must be capable of:

1. Recognizing interference, jamming, or deception

2. Reporting information intelligently and taking appropriate countering action

3. Selecting the appropriate type of equipment to counter each variation of enemy ECM

4. Obtaining the best possible performance from their equipment in an ECM environment

5. Integrating various combinations of ECCM techniques and antijam circuitry

6. Reading through any remaining jamming or deception.

8.4.5.2 (C) Reaction to Enemy ECM. Jamming is an involved and expensive operation requiring complicated equipment and skilled personnel. An enemy will not expand jamming efforts without a definite goal. Almost invariably, jamming will be part of well-defined plan which will indicate that a significant enemy action is imminent or in progress. The success of the jamming effort will be determined to a great extent by the reaction of the radar, ECCM, and ESM operators. The degree of success of the enemy action may be affected markedly by the expeditious and accurate report of jamming. Knowledge of the employment of jamming and the time and location of employment are of great value to the tactical commander in analyzing the enemy's action and determining appropriate countermeasures.

8.4.5.3 (C) Recognition is the first and most crucial step when deception or jamming is encountered. As soon as the ESM or radar operator recognizes an interference signal as jamming, he must report its existence to his immediate supervisor, who will ensure that it is relayed as expeditiously as possible to the OTC. The radar, ECCM, and ESM operators will observe the jamming signal to establish its:

1. Direction

2. Strength

3. Effectiveness

4. Frequency

5. Type

6. Time first observed.

8.4.5.4 (C) Logs and Reports. The ECCM operator must maintain a log of all jamming and record which ECCM circuits were an effective countermeasure. To update the enemy EOB, he must submit a report including:

1. Time and date of jamming

2. Type and frequency of equipment jammed

3. Position of jammer or direction from which jamming was received

4. Type of jamming

5. Jamming strength and effectiveness

6. Jamming bandwidth coverage

7. Jamming modulation type and frequency

8. Synchronized or nonsynchronized reception

9. General appearances of jamming on the radarscope

10. Effects of any ECCM circuits employed.

8.4.5.5 (C) General Procedures For the ESM Operator. The ESM operator must be thoroughly familiar with the operating frequencies, bandwidths, and frequency agility capabilities of all installed electronic equipment. He must be particularly alert for jamming on any of the operating frequencies. His immediate report of jamming will alert the appropriate operators to the jamming, enabling them

to take appropriate countermeasures. His identification of the type of jamming, jamming modulation,and jammed bandwidth will aid immeasurably in selection of the proper ECCM techniques and antijam circuitry to be employed by the radar operators. He must also maintain threat signal surveillance since ECM may well be used as a diversionary play.

8.4.5.6 (C) General Procedures For the Radar Operator. The radar operator must be thoroughly familiar with the appearance of the various types of jamming and deception on his particular equipment. CCM Operational Techniques (SMS-TG-670 series), Electronic Countermeasures (NAVPERS 92440C-5), and Radarman 3rd and 2nd training manual (NAVPERS 10144-B) contain information and examples of jamming displays and appropriate ECCM fixes.

(C) The radar operator must also be familiar with the various ECCM circuits and techniques available for use with his equipment and with their effects on jamming, deception, and targets. He must be aware of the fact that antijam circuits should only be employed when their action is required since they tend to degrade the normal capability for target detection. Above all, he must be alert to detect active jamming or deception and to report it as expeditiously as possible to his immediate superior and his ECCM operator. When jamming is received, most attention should be provided to the jammed sector or area of the scope. Jamming is an effective diversion, so all-around surveillance must be maintained. The edges of the jammed area should be observed carefully since a common use of jamming is to provide secondary screening for other targets. Even with the most careful coordination between jammers and targets, the targets at times may move outside the jammed area. The radar operator must be alert for changes in the jamming pattern or strength to assist the ECCM operator to obtain the best presentation.

(C) The primary purpose of the radar operator is to detect and/or track targets. When ECM is encountered, all of the ECCM actions must be directed toward this primary function. Removal of the ECM indications from the scope is only incidental to the main objective. Since the activation of antijam circuitry degrades the normal target presentation capability of the radar, this circuitry should be employed with great care. It is most important that radar operators consider the degradation of the presentation on their scope by jamming compared to the degradation of their scope presentation by ECCM circuitry. It may be necessary to operate the circuitry part of the time to observe certain areas and to deactivate the circuitry at other times to observe weak targets on other portions of the scope.

(C) Restrictions on the indiscriminate use of active ECCM features in the presence of enemy surveillance units are described in relevant OPNAV and Fleet Commanders' instructions.

8.4.5.7 (C) General Procedures For the ECCM Operator. The sophisticated radars now in use have an excellent capability to detect targets in a heavy jamming environment. When jamming is encountered, the ECCM operator should not wait until the presentation is markedly degraded. He should analyze the jamming and experiment as necessary with the various circuits available to find the most suitable combination of ECCM circuits to combat the jamming. He must exercise caution during this process to ensure that he does not degrade the radar operator's presentation over an extended period of time and cause him to fail to detect targets. The ECCM operator must work closely with the radar operator to provide the most desirable presentation at any given time. Figure 8-2 lists the various forms of jamming which may be encountered and provides a guide to the selection of ECCM techniques for correcting each form of jamming.

(C) When jamming is encountered, the ECCM operator must determine:

1. Bearing of the jammers
2. Jammer strength and effectiveness
3. Frequencies being jammed
4. Type of jammer being employed
5. Proper ECCM circuit to be employed.

ANTIJAMMING CONTROL/ TECHNIQUE	REFLECTIVE DECEPTION	TRANSMISSION DECEPTION	BROADBAND NOISE	NARROW BAND NOISE	SAW TOOTH MODULATION	PULSE MODULATION	FREQUENCY MODULATION	SINE WAVE MODULATION	SLOW SWEPT FREQUENCY	FAST SWEPT FREQUENCY	UNMODULATED CW
STC	X										
FTC	X			X	X	X		X			
AVNL		(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	
AGC		(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	
IAGC	X			X	X	X		X			
LOG						X			X		X
LIN-LOG						X			X		X
DICKE FIX			X	X	(1)	(1)	X			X	(1)
SLB	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)
SLS	X	X	X	X	X	X	X	X	X	X	X
PC		X	X	X	X	X	X	X	X	X	X
PWD	X		X	X	X	X	X	X	X	X	X
PAD		X	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)
P-COMP		X	X	X	X	X	X	X	X	X	X
MTI	X										
VI			X	X	X	X	X	X	X		X
PRF JITTER		X									
JAM STROBE			X	X	X	X	X	X	X	X	X
RANGE RATE MEMORY	X										
PULSE EDGE TRACKING	X										
FREQUENCY DIVERSITY		X	X	X	X	X	X	X	X	X	X
FREQUENCY AGILITY		X		X	X	X	X	X	X	X	X
POWER INCREASE		X	X	X	X	X	X	X	X	X	X

(1): Do not use; will have adverse effect. X: Useful technique. Blank: No effect.

Figure 8-2. (C) Selection of ECCM Techniques

The data compiled by the ECCM operator must be transmitted to the CIC evaluator so that a unified ECCM effort may be obtained. He must be alert for changes in the jamming environment and make appropriate changes in the ECCM circuitry to combat these changes.

(C) One of the most important tools of the ECCM operator is the A scope which presents an excellent display of the jamming signal characteristics and assists in defining the type of jamming employed. After determining the type of jamming, the ECCM operator selects the appropriate ECCM circuits and observes their effects on the jamming signal on both the A and PPI scopes. In the more sophisticated modern radars, he is able to insert ECCM circuits affecting the presentation on his own scope without affecting the presentation on the radar operator's scope.

8.4.5.8 (C) General ECCM Procedures. When an enemy is attempting to prevent our force from seeing targets, it is imperative that every attempt be made to break through his electronic screen. All radars, both search and fire control, should be employed to increase enemy jamming requirements and our force's probability of intercept. Since the enemy cannot be sure which transmissions are being used to locate his force, he may dilute his jamming endeavor in order to jam all of our radars. Similarly, our force must avoid taking any action which will give the enemy any indication of the effectiveness of his jamming.

(C) Some fire-control and missile-control radar systems with automatic tracking capabilities have an alternate manual mode of operation which can be employed if deceptive jamming is used to break lock after target acquisition. All radar operators should be alert to detect loss of target by automatic tracking systems due to jamming, and revert promptly to manual operation where such an option is provided. In general, manual operation is much more resistant to jamming than automatic tracking, and can be an effective ECCM technique.

8.4.6 (C) Communications Counter-Countermeasures (COMCCM) can be divided into two categories: antijamming measures and antideception measures.

8.4.6.1 (C) Antijamming Measures to counter or minimize the effect of jamming consist of the following:

1. Preparation of instructions and procedures to be followed (including alternate routing of traffic) on circuits most susceptible to jamming.

2. Frequency shifting, if possible, by large steps in the frequency spectrum. If frequency shifting is to be carried out effectively, the organization must be preplanned. The following should be considered:

   — Since all stations may not be jammed at the same time or to the same degree, it will be necessary for the shift in frequency to be ordered. This signal should be passed over an alternate channel.

   — The order to shift frequency must not include the new frequency in the clear, and code words should be established to initiate the shift.

   — Arrangements should be made for transmissions by at least one station to continue on the old frequency to avoid the shift being discovered by the enemy.

   — Use of different call signs and operators.

3. Slight retuning, and/or reduction in bandwidth of receiver.

4. Increasing power of transmitter.

5. Altering modulation; for example, from voice to CW.

6. Frequency diversity.

7. Ensuring correct bearings and maximum efficiency of directional antennas for both receiving and transmitting when available.

8. Sideband shift.

9. Use of broadcast intercept control.

8.4.6.2 (C) Antideception Measures to counter the effect of deception consist of the following:

1. Shifting frequency, same as in item 2 of paragraph 8.4.6.1.

2. Authentication.

— Operators must be prepared to AUTHENTICATE PROMPTLY.

— Proper procedures in authentication MUST BE STRICTLY ADHERED TO.

3. Strict circuit discipline.

4. Do not use operators who have easily imitated peculiarities in sending.

5. Switch operators only when necessary.

8.4.6.3 (C) General Procedures For the Radio Operators. The term "radio operator" includes anyone who makes use of radio equipment in tactical operations and who may, at any time, encounter enemy jamming and/or deception. Radio operators must be throughly familiar with the current communications operating plan and radio circuit procedures. They must be alert for enemy jamming and/or deception on the nets and, if detected, report it immediately to the CIC evaluator. Since authentication is the best means of combating imitative deception, radio operators must be thoroughly familiar with its use and must both perform and require authentication promptly. Strict adherence to proper voice procedures is mandatory.

8.4.6.4 (C) General Procedures For Aircraft Control. The opposing force must be expected to employ communications jamming/deception against intercept aircraft and their controlling stations, whether airborne or surface. They will take every opportunity to interject false information and jam or disrupt communications with the intercepting aircraft in order to prevent it from locating and destroying their attacking units. The interceptor/controller team must be thoroughly familiar with the various types of communications jamming/deception and how to counteract them at once, using appropriate techniques described in the preceding paragraphs. The most effective techniques to overcome communications countermeasures include:

1. A prearranged frequency shift plan which the pilot/controller must implement immediately when jamming/deception is encountered.

2. Implementing an authentication plan to negate deception efforts.

3. Not alerting the countermeasures operator nor divulging how effective his efforts are.

4. Often times the controller can transmit short concise commands which the pilot can receive through jamming. By observing the movement of the interceptor on radar, the controller can determine if his commands are being received and complied with.

5. Use of Link-4A to counter communications deception.

CHAPTER 9

Emission Control

9.1 (U) DEFINITION

(U) Emission control (EMCON) is a means of selectively managing electromagnetic, acoustic, or other emissions to minimize detection for operations security by enemy sensors/mutual interference among friendly systems and/or to execute a military deception plan.

9.2 (C) CONCEPT

(C) The concept of EMCON is to start from a condition of total electronic silence and then, through selective radiation of specific emitters, ensure the objective of management of emissions is accomplished. This objective is reached when the OTC is assured that the tactical advantages derived from the employment of intraforce emitters are of greater benefit to his own force than to the enemy.

(C) With effective management of emissions it is possible to obtain optimum use of the frequency spectrum to accomplish an assigned mission. EMCON should be exercised to minimize the useful intelligence an enemy can obtain by passive intercept while maximizing the useful information gained by force sensors.The objective may also be to reinforce a deception pattern of an operational deception (OPDEC) plan.

(C) All emissions which occur in the electromagnetic spectrum and the acoustic environment must be included in EMCON procedures. Command structure must provide positive EMCON management to maintain the ability to remain silent or selectively emit as the tactical situation dictates.

9.3 (C) PURPOSE

(C) Emissions should be managed for tactical advantage in any situation. Tactical advantage may be gained or enhanced by judicious EMCON which prevents the following.

9.3.1 (C) Force Detection. One of the primary functions of EMCON is to deny the enemy the ability to detect own forces through the intercept of electromagnetic or acoustic emissions. This objective is most easily obtained by the OTC not authorizing the radiation of any emitters. This decision must be continuously weighed against the knowledge that the ability of the force to detect the enemy, other than with assets external to the force (for example, intelligence) or through ESM, is dependent on some form of radiation. While complete silence may encourage the enemy to employ his active sensors, the OTC must weigh the capability of his force to detect, identify, and DF those sensors and the probability that he can exercise tight discipline over own force emissions.

(C) One alternate to complete silence is the use of early warning aircraft equipped with both radar and ESM while the remainder of the force is silent. If early warning aircraft are not available or the OTC determines that additional active sensor coverage is required, he must decide how many are required to maintain force integrity and how they are to be employed (for example, randomly, time sharing plan, frequency diversity).

9.3.2 (C) Unit Identification. Even though an enemy may be aware of the existence and general location of a force, considerable reconnaissance efforts may be required to determine force composition, disposition, and probable intentions. The judicious use of EMCON, especially not radiating unique emitters, varying the parameters of the radiating radars, and changing the frequency of communications circuits in use may magnify the enemy's problem; and may even require visual reconnaissance to obtain detailed friendly force information. If emitters are being time shared, at least one of the parameters should be changed during each silent period.

(C) Unique emitters (those which identify a specific type of unit) must at all times be judiciously controlled. Emissions such as carrier controlled approach (CCA) and missile radars may identify both the platform and its offensive/defensive capabilities.

(C) To further reduce the enemy's ability to identify specific units, on-board and off-board decoys may be employed to deceive his active sensors.

9.3.3 (C) Passive Force Localization. Once the force has been detected and it is believed that specific units are identified, the objective is to deny the enemy a favorable firing solution. Intermittent sensor operation can make passive tracking more difficult. Various deception efforts coupled with on-board and off-board decoys and intermittent sensor operation may delay or disrupt the enemy's launch/firing sequence.

9.3.4 (C) Counter Engagement Electromagnetic and Acoustic Interference (EMI). Even when an attack is in progress, consideration must be given to which emitters should be employed. One consideration is the ability of antiradiation missiles (ARMs) to home on some specific emissions. Another consideration is the degradation of own force capabilities by electromagnetic and acoustic interference. To prevent degradation of own force efforts, it is frequently necessary to restrict radiations for the following reasons:

1. Provide own ESM equipment the best environment in which to operate for maximum effectiveness.

2. Prevent performance degradation of own electromagnetic and acoustic radiating equipment caused by intership and intraship mutual interference.

3. Avoid hazardous electronic radiations to personnel and ordnance (HERO).

9.4 (C) EMCON PLANNING AND DECISION MAKING

(C) In planning EMCON tactics, it is necessary to consider all factors related to EMCON decision making. Of particular importance are the following factors that establish the enviroment in which EMCON decisions are made.

1. Mission	Sea Control — Power Projection — Presence
2. Area	— Open Ocean — Confined Sea — Base Supported
3. Level of Tension	— Normal Operations — Crises — Hostilities
4. Threat	— Submarines — Aircraft — Ships — Missiles — Mines — Satellites — Shore-based Intercept Site Radars Ashore — Passive Sonar Surveillance Systems

5. Purpose

— Prevent Force Detection
— Prevent Unit Identification
— Prevent Passive Force Localization
— Prevent Counterattack Interference
— Support Deception to Gain Advantage and Maintain Security
— Prevent Mutual Interference

(C) Figure 9-1 is a flow diagram representing the recommended procedure for EMCON planning and tactical review. The rectangles down the left-hand column represent the planning steps while those down the right-hand column represent tactical review steps. Figure 9-2 is a checklist for accomplishing the action steps presented in the flow diagram. Use of the flow diagram and checklist will ensure consideration of important factors affecting EMCON decisions.

9.5 (C) PROMULGATING EMCON PLANS

(C) Specific EMCON plans are promulgated utilizing the EMCON format (Figure 9-3). This format is designed to facilitate development of standardized, flexible, and easily promulgated EMCON plans. These plans may appear in an OPORD or may be promulgated by various means consistent with the EMCON plan in effect. The individual EMCON plans will be promulgated by the OTC and assigned a letter designator. The OTC will continuously review the existing EMCON plan and modify the force electronic or acoustic profile as the tactical situation changes to optimize the force readiness posture.

(C) In the EMCON format, each type of unit is identified by an index letter(s). The various emitters are categorized by frequency and emitter functions are designated by index numbers. Radiation status indicators (RSI) from Figure 9-4 are used with the EMCON format to establish the status of a specific emitter within the force.

9.5.1 (C) Breaking EMCON. In a tactical emergency, the effective EMCON condition, regardless of its stringency, may be broken by a single unit. Should a picket, for example, have indications of an approaching threat, it should not hesitate to provide warning to the force via a reporting net. A destroyer in the screen that detects a submarine should make the threat known.

(C) Until the OTC alters the EMCON conditions, only the initial detecting unit will report the intercepted threat. Unless otherwise specified by the OTC, a violation of the EMCON plan in effect by a siglee unit is not the signal for all units to activate communications and other emitters.

(C) If a unit passively detects electromagnetic or acoustic radiation and evaluates the emission as one from a specific, immediate threat to the force, the unit may employ the system that is best suited for detection of the emitter platform as determined by the TAO, regardless of the EMCON plan in effect at the time.

9.5.2 (U) Monitoring EMCON. Once the OTC promulgates an appropriate EMCON plan to the units in the force, he should arrange for continuous monitoring of the force EMCON (especially those units without a self-monitoring capability) to ensure immediate control of unauthorized emissions.

9.6 (C) EMCON BILLS

(C) Depending on the tactical situation which dictates the requirements for use of active radiating devices, each ship must be able to effect an EMCON condition change rapidly and accurately. The integrity of the ship or the task force can depend on the positive, rapid response of each ship to EMCON changes. To optimize the reaction to EMCON changes, each ship will prepare an EMCON bill. The individual ship's EMCON bill will provide for implementing the EMCON plan in effect by:

1. Outlining planning considerations for establishing the appropriate shipboard emitter status.

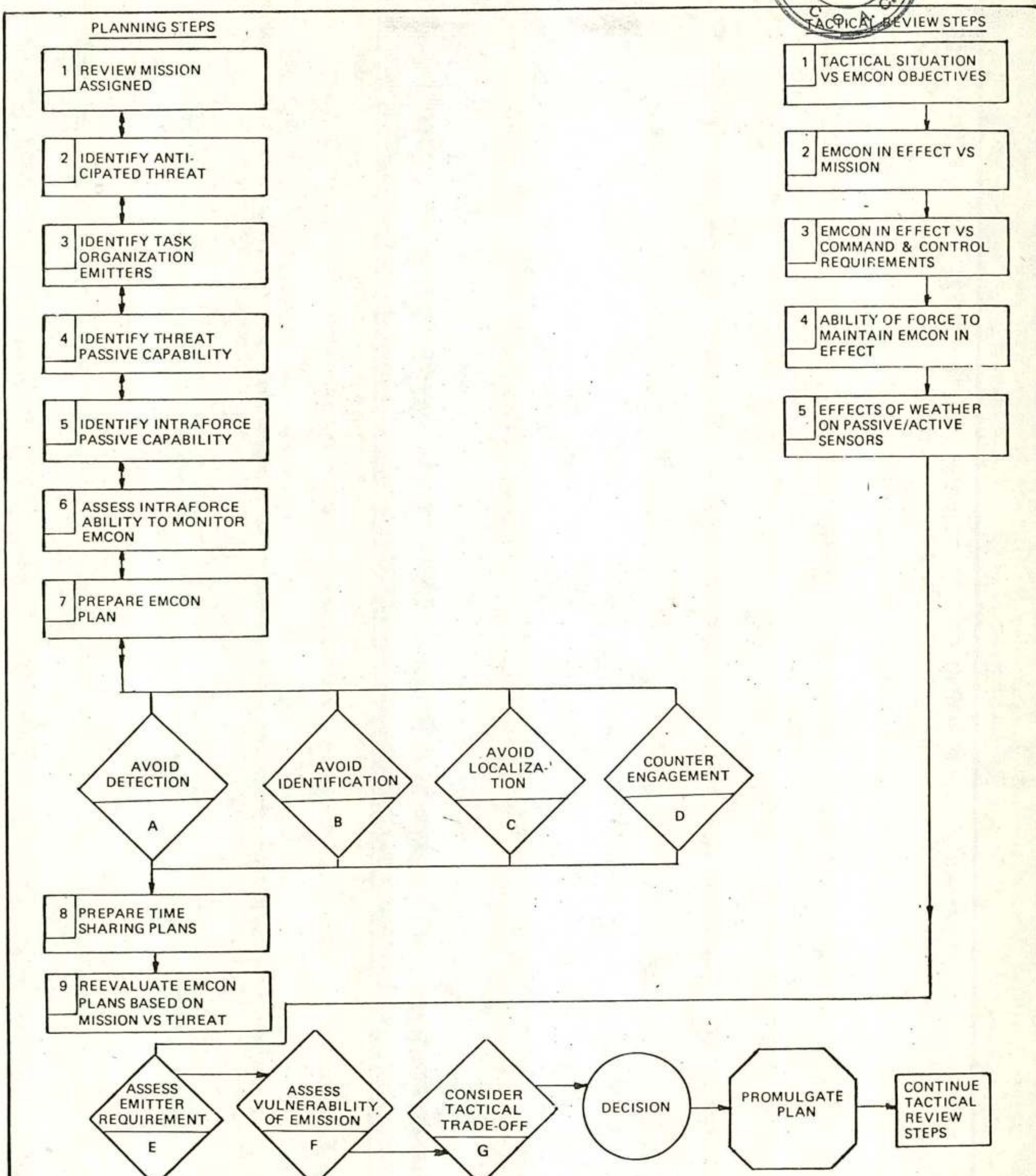


Figure 9-1. ~~(C)~~ EMCON Planning and Tactical Review Flow Diagram

Checklist for EMCON Planning

A. EMCON PLANNING

Steps	Recommended Approach
1. Review mission assigned.	Establish as clearly as possible requirements to successfully complete mission. In addition to offensive requirements, consider command and control, training, material readiness, safety requirements.
2. Identify anticipated threat.	List threats in order of priority within categories and frequency. Use cataloged and current intelligence. It is essential to have understanding of the capability of the enemy to detect, localize, and classify friendly forces with both passive and active sensors. Make arrangements for receipt of appropriate current intelligence and environmental data to include land-based, surface, subsurface, airborne, and orbital threats from sources such as NAVINTSUMS, MERINTSUMS, satellite vulnerability reports, SHARPS, ASRAPS, and refraction data analysis.
3. Identify task organization emitters.	Require assigned units to confirm installed emitters. Publish in OPORD matrix of emitters on assigned units. Determine unique emitters and assign specific parameters to prevent or reduce interference.
4. Identify threat's passive capability.	List the passive capability and platforms in which installed for each anticipated threat. The ability of the enemy to disseminate and respond to new information by each of the expected platforms are to be defined. The list should show which intraforce emitters are vulnerable to intercept by each of the anticipated threats including land-based and satellites.
5. Identify intraforce passive capability.	List the ability of own force to detect, identify, and DF threat emissions by passive sensors. Similarly, own force emitters which could mask the detection of threat emitters should also be identified.
6. Identify intraforce ability to monitor the EMCON in effect.	The OTC must be assured that his force has the ability to effectively and continuously monitor the policy in effect. An EMCON violator could tactically be as devastating as an enemy torpedo or missile.
7. Prepare EMCON plan compatible with threat, mission, and operational deception plan.	Each condition should correspond with a different threat and mission requirement.
– Avoid detection	Total silence.
– Avoid identification	Keep unique emitters silenced.
– Avoid localization	Employ deception, electronic and mechanical masking.
– Counter engagement	Activitate necessary sensors to detect, acquire, and engage enemy units including missiles. Employment of ECM and DECM must again be addressed.
8. Prepare electronic/acoustic time sharing plans.	After preparing various EMCON plans based on anticipated tactical situations, the OTC must determine the minimum number of emitters to maintain force integrity. This may either be done on a unit (guardship) basis or with time sharing plans wherein the majority of units are involved but each for only a relatively short duration.

Figure 9-2. (C) Checklist for EMCON Planning

9. Reevaluate EMCON plans.	Upon completion of the above steps, the OTC should be able to assess the validity of the proposed EMCON plans with a corresponding subjective creditability for each. Of primary importance is for the OTC to be able to judge each plan as to its ability to assist in retaining the tactical advantage.

B. EMCON TACTICAL REVIEWS. The following steps should be reviewed continously:

1. Tactical situation versus objectives of EMCON plan currently in effect.
2. EMCON in effect versus mission assigned.
3. EMCON in effect versus command and control requirements.
4. Ability of force to maintain EMCON in effect.
5. Effect of weather in increasing or decreasing detection range of active/passive sensors.

C. SUBSTEPS below detail construction and review of the EMCON plan, and apply to individual as well as OTC decisions to maintain emitter silence, employ selected emitter, or silence emitter being radiated.

Required Steps	Suggested Approach
1. Assess emitter requirement.	Before an emitter is authorized for radiation, the purpose and objective to be obtained from the employment of that emitter needs to be reviewed and necessity affirmed.
2. Assess vulnerability of emission	Review of the probability of detection and unit identification through enemy passive intercept must be weighed against the tactical benefits expected through the employment of the emitter.
3. Consideration of tradeoffs.	See note following.
4. Decision.	See note following

NOTE: Consideration of tradoffs and decision.

Tradeoffs must be assessed and decisions made on required emissions as dictated by the tactical situation. Whenever possible, when the radiation of an emitter or emitters enables accomplishment of the assigned mission while simultaneously minimizing vulnerability, and where the tactical gains outweigh the losses, the emitter can be employed. In assessing tradeoffs three broad questions arise:

1. What advantages/disadvantages accrue to own force as a result of allowing selected emitters to be radiated or keeping them silent?

2. Will the enemy gain information, be confused, or lose information as a result of the proposed emission posture change?

3. Are the consequences of the opposition's information gain justified by the advantages realized in changing the emission posture?

Figure 9-2. (C) Checklist for EMCON Planning (Cont.)

The first question is the most easily answered. A change in emission status my result in an increased capability in the area of command and control, sensor capability, weapons and personnel readiness, while preventing force dectection, identification, or it may lure the enemy into a weapons trap. The value of the advantages gained in terms of mission accomplishment by the emission status change must be carefully considered.

The second question, that of the advantages which accrue to the opposition as a result of the action considered, is not easily answered. The capability of the opposition to obtain information as a result of the proposed action must be assessed in terms of his ability to utilize the information to obstruct the mission of friendly forces. Three possible conclusions which may be reached are:

1. The information gained would provide no increase in the enemy's capability to obstruct the mission.

2. The information gained would cause the enemy to arrive at an erroneous conclusion which would be advantageous to the friendly forces.

3. The information gained would enable the enemy to obstruct the mission.

If the conclusion reached is that the enemy would not increase his capability to obstruct the mission, the decision is not difficult. The conclusion that the enemy would probably markedly increase his knowledge as a result of the employment of selected emitters leads then to the crucial question. The increase in the opposition's knowledge as a result of the action must be weighed with respect to the enemy's ability to use that knowledge to obstruct the mission. The result of this consideration is then compared with the favorable results hoped for by authorizing the radiation of the emitters under consideration. Only then can a decision be made to carry out a particular change in the EMCON plan.

Figure 9-2. (C) Checklist for EMCON Planning (Concl.)

INDEX NUMBERS		
SEARCH/HEIGHT FINDERS	10	ALL BANDS
	11	A/B BANDS – 0 - 500 MHZ
	12	C/D BANDS – 500 - 2000 MHZ
	13	E/F BANDS – 2000 - 4000 MHZ
	14	G/H BANDS – 4000 - 8000 MHZ
	15	I BANDS – 8000 - 10000 MHZ
	16	J BAND – 10000 - 20000 MHZ
	17	K BAND – 20000 - 40000 MHZ
	18	
	19	AI RADAR
	20	CCA RADAR
	21	
	22	
	23	
	24	
	25	
	26	
	27	
	28	
	29	
FC/MC RADARS	30	ALL BANDS
	31	E/F BANDS
	32	G/H BANDS
	33	I BAND
	34	J BAND
	35	K BAND
	36	
	37	
	38	
	39	
ELECTRONIC WARFARE EQUIPMENT	40	ALL JAMMERS
	41	A/B BAND JAMMERS
	42	C/D BAND JAMMERS
	43	E/F BAND JAMMERS
	44	G/H BAND JAMMERS
	45	I BAND JAMMERS
	46	J BAND JAMMERS
	47	K BAND JAMMERS
	48	
	49	
	50	ALL DECM
	51	E/F BAND DECM
	52	G/H BAND DECM
	53	I BAND DECM
	54	J BAND DECM
	55	K BAND DECM
	56	
	57	
	58	
	59	COMMS JAMMERS
NAVIGATION AIDS	60	ALL NAV AIDS
	61	UHF/VHF BEACON
	62	LF/MF BEACON
	63	RADAR ALTIMETER
	64	IFF INTERROGATOR
	65	IFF TRANSPONDER
	66	HELO TRANSPONDER
	67	TACAN
	68	DOPPLER EQUIPMENT
	69	AEW RELAY
ACOUSTIC EQUIPMENT	70	ALL EQUIPMENT
	71	FATHOMETERS
	72	U.W. TELEPHONE
	73	NOISEMAKERS
	74	SIMULATORS
	75	SHORT RANGE SONAR
	76	MEDIUM/LONG RANGE SONAR
	77	EXPLOSIVE ECHO RANGING
	78	
	79	
COMMUNICATIONS EQUIPMENT	80	ALL UHF
	81	UHF SHIP
	82	UHF AIR
	83	ALL VHF
	84	ALL MF/HF
	85	MF/HF SHIP
	86	MF/HF AIR
	87	MF/HF SHIP SHORE
	88	ALL SHF
	89	HF DATA LINK
	90	UHF DATA LINK
	91	ALL TRANSMITTERS
	92	ALL RECEIVERS
	93	
	94	METAIDS/RADIOSONDE
	95	
	96	
	97	
	98	
	99	

	TACTICAL UNITS
A	CV
B	CV ESCORTS
C	DLG/DDG/DD
D	CG/CLG
E	ALL SHIPS
F	ALL AIRCRAFT
G	CV FIXED WING AIRCRAFT (VS)
H	HELOS
I	AAW SURFACE PICKET
J	AEW AIRCRAFT
K	CAP AIRCRAFT
L	STRIKE AIRCRAFT
M	RECONNAISSANCE AIRCRAFT
N	TANKER AIRCRAFT
O	ELECTRONIC AIRCRAFT (WARFARE)
P	VP AIRCRAFT
Q	ASW SAU
R	SURFACE ACTION GROUP
S	NAVAL GUNFIRE SUPPORT GROUP
T	UNDERWAY REPLENISHMENT GROUP
U	UNDERWAY REPLENISHMENT GROUP ESCORTS
V	CONVOY (MERCHANTS)
W	CONVOY ESCORTS
X	AMPHIBIOUS FORCES
Y	AMPHIBIOUS ESCORTS
Z	MINESWEEPERS
AA	AUXILIARIES
AB	FAST PATROL BOATS
AC	
AD	
AE	
AF	
AG	
AH	

Figure 9-3. (C) EMCON Format

ALPHA	Safety – Equipment may be operated if essential to safe conduct of operations.
BRAVO	Active – Sonars are to be operated in the active mode.
ECHO	Essential Missions – Minimum radiation is to be used involving the radiation of electromagnetic and acoustic equipment only to the limited degree and for the minimum time required to accomplish a specific mission or task.
GOLF	Guard – Designated unit(s) is to operate equipment or maintain guard on designated circuits on behalf of other units (IFF guards keep parent radar silent).
HOTEL	Helicopter Operations – Essential operation is authorized by units directly involved in the direction of helicopters.
LIMA	Launching and Landing Aircraft – Essential operation is authorized when launching and landing aircraft.
OSCAR	Operation is Directed – Must be operated in the active mode. Will be used to simulate the traffic normally associated with those circuits.
SIERRA	Silence – No emissions are to be made except the standard occasions for breaking EMCON. Equipment is to be in a high state of readiness without actual radiation.
TANGO	Time Sharing – Equipment is to be operated in accordance with the time sharing plan in effect between units of the force. Unique emitters identified by the OTC are not to be radiated. (See Note.)
XRAY	Total Silence – No emission authorized. Equipment main power source secured.
NOTE: Each time a radar and/or sonar is placed in the standby/passive mode, one or more of the equipment parameters is to be changed (that is, frequency, PRF, PW, SPR) before it again is radiated.	

Figure 9-4. (C) Radiation Status Indicators (RSI)

2. Reflecting the specific duties and responsibilities of all personnel exercising control of electromagnetic or acoustic emitters.

3. Establishing an emission control center (ECC) with overall responsibility for shipboard emitter radiation status.

4. Designating intermediate control stations (ICS) as necessary through which specific equipments are controlled.

5. Designating individual responsibility for each shipboard emitter.

6. Providing procedures for:

— Intraship reporting

— Verification (check off) of emitter status

— Monitoring own ship emitter status.

(C) Figure 9-5 shows a sample organization for shipboard EMCON. Appropriate guidance for each EMCON plan must be posted at each station or space with responsibility for setting or monitoring a given EMCON plan. Figure 9-6 shows a sample ship's emitter status table which might be posted in the ships ECC. Figure 9-7 shows a sample card which could be posted at each control location of a given emitter. Action required indicators such as the following could be defined on the back of the card:

1. Power secured at source

2. In standby

3. Ready in dummy load

4. In radiate.

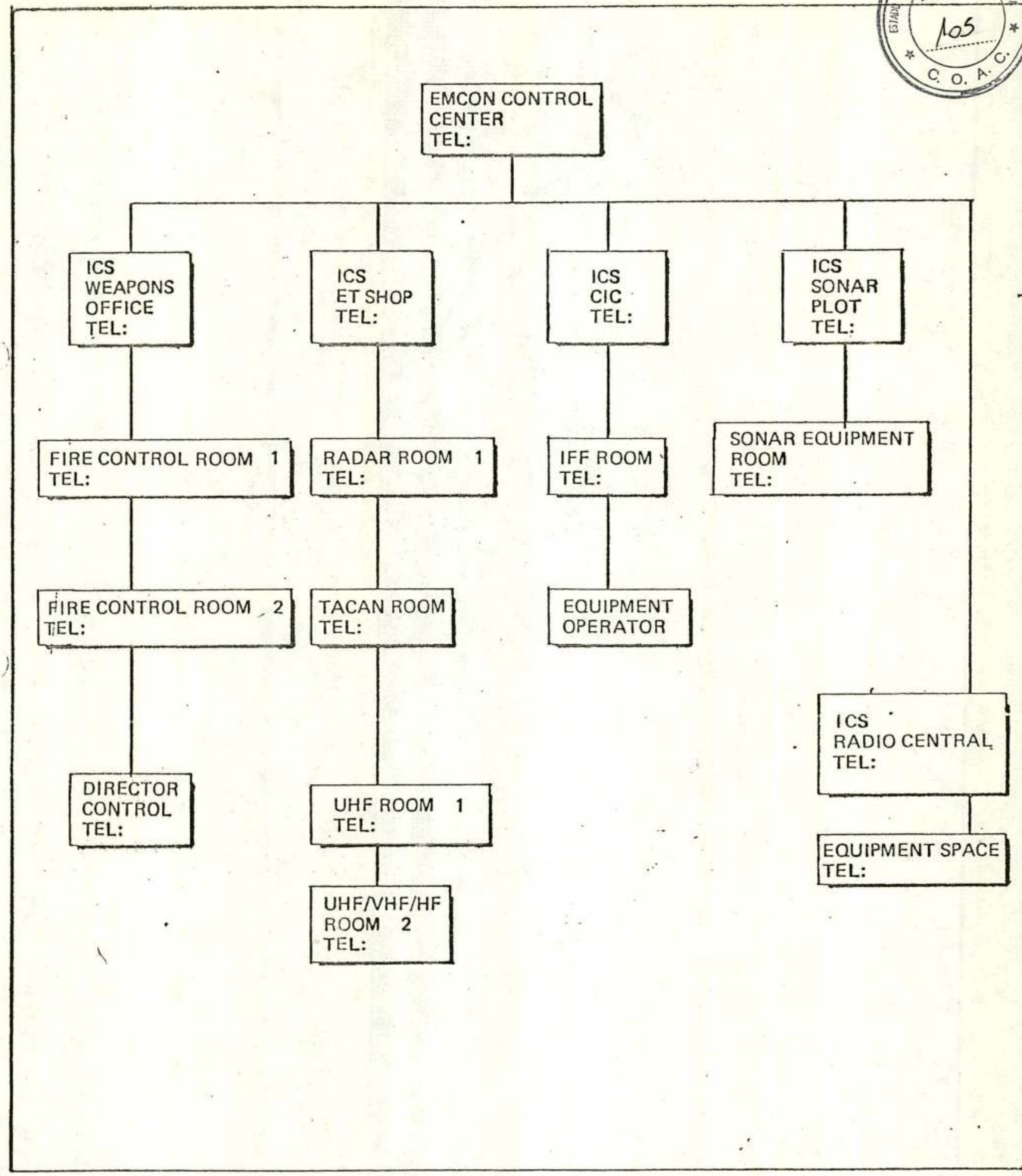


Figure 9-5. (C) Shipboard EMCON Organization

EMCON GUIDE

EQUIPMENT: LINE NR.

PERSON SETTING EMCON:

CONDITION SET:

DATE/TIME SET:

AFTER EMCON CONDITION SET, REPORT STATUS TO ______________________

TEL:

EMCON PLAN

	ALFA	BRAVO	CHARLIE	DELTA	ECHO	OTHER
ACTION REQUIRED						

Figure 9-7. (C) EMCON Guide Card

CHAPTER 10

Amphibious Operations

10.1 (U) CONCEPT

Electronic warfare actions will be planned and executed as an integral part of amphibious operations. EW management must be integrated into the operational command structure of the amphibious task force (ATF). Amphibious EW involves the military employment of electromagnetic equipment, systems, tactics, and techniques for the purpose of:

1. Determining hostile activity in the electromagnetic spectrum

2. Exploiting hostile use of the electromagnetic spectrum

3. Retaining our own effective use of the electromagnetic spectrum.

10.2 (U) RESPONSIBILITY

Naval commanders are responsible for the planning and conduct of all operations required for their own protection and for accomplishment of assigned EW tasks en route to the engagement area, during the engagement, and after retirement. While embarked in naval units of an ATF, landing force units are responsible for and will conduct only those operations specifically assigned by the commander, amphibious task force (CATF). During the planning phase, matters on which various force commanders are unable to agree shall be referred to their common superior for a decision. Amphibious warfare commanders have the following planning responsibilities:

1. The CATF will develop or direct subordinate naval commanders to develop EW plans for naval support units.

2. The commander, landing force (CLF), will formulate his EW concept as required for support to troop operations and determine the EW support required from naval forces. It is imperative that this concept be formulated as early as possible since it is the basis for other planning.

3. Once the CLF's EW support requirements of naval forces are accepted, the CATF will develop plans for supplying this support.

4. The CLF will develop or direct subordinate commanders to develop EW plans for the landing force.

10.3 (U) OPERATIONS

10.3.1 (C) Pre-Engagement/Embarkation. On commencement of amphibious operations, the CATF is the operational command authority over all component parts of the ATF. In the case of the landing force this authority begins at the time of embarkation. Therefore, responsibility for EW control and coordination is vested in the CATF during this phase. The geographical location of the embarkation point/area will influence task force EW requirements and procedures since the embarkation may occur in a relatively advanced area.

10.3.1.1 (C) ESM. The CATF will assign intercept guards throughout the radio frequency spectrum to:

1. Provide early warning of threat electromagnetic emissions

2. Aid in electronic recognition and identification

3. Provide information necessary to effect jamming of enemy electromagnetic emission

4. Monitor own use of the radio frequency spectrum

5. Gain intelligence from enemy's use of transmitting devices.

10.3.1.2 (C) ECM. During this phase, participating naval and troop units do not ordinarily engage in jamming except as a defensive measure or as directed for training.

10.3.1.3 (C) ECCM. The CATF and other responsible commanders in the embarkation areas will prescribe and rigidly enforce the appropriate condition of electronic silence in order to prevent the enemy from obtaining useful tactical information by interception of electronic emissions.

10.3.2 (C) Amphibious Rehearsal. During the amphibious rehearsal phase, attention must be accorded to special or unusual problems which may be encountered in the actual operation. All EW activities conducted during this period are the same as those to be employed in the actual assault as set forth in paragraphs 10.3.3 and 10.3.4. When unauthorized observation and monitoring of the amphibious task force are likely, it will be necessary to establish perimeter patrols around the rehearsal area, both at sea and ashore. Monitoring and ESM must be undertaken to achieve communications security and preclude unauthorized external radiations from own force.

10.3.3 (C) Movement Phase. During movement to the objective and/or rehearsal area, responsibility for use of EW continues to be vested in the CATF.

10.3.3.1 (C) ESM. When possible, intercept search should be continued so that all available information on enemy equipment and procedures will be obtained. Intercept and jamming should continue simultaneously if:

1. There is adequate frequency or geographic separation between the equipment

2. The jammer is sufficiently directional, or

3. There is adequate coordination on a time-shared basis.

10.3.3.2 (C) ECM. Units will execute previously prepared ECM plans and be prepared to conduct other ECM operations as directed by the CATF. Designated units must be prepared to perform ECM against enemy electronic equipment. Jamming may be ordered when tactically more advantageous than interception.

(C) Designated units must be prepared to use electronic deception as directed by the CATF. Deception may be accomplished by:

1. Simulating the presentation of own forces on enemy radars by use of decoy radar reflectors

2. Simulating false submarine activity by dropping simulators

3. Dropping friendly radar simulators to confuse the enemy coastal defenses and cause possible scattering of enemy forces

4. Assigning special units with a credible number and mix of ships to simulate major forces in order to draw enemy attention away from the actual objective area

5. Creating confusion in the amphibious operational area (AOA) by pre-seeding with chaff

6. Simulating false activity by sending spurious messages from detached units.

10.3.3.3 (C) ECCM. The element of surprise is often the key to successful amphibious operations against a highly mobile enemy, particularly in the counterinsurgency environment. EMCON will help ensure surprise by denying the enemy the electronic intelligence to determine the force movement and strike/objective area.

10.3.4 (C) Advance Force Operations. EW responsibility remains vested in the CATF during pre-D-day operations. However, certain specific responsibilities are normally delegated to the commander of the advance force who informs the CATF as soon as practicable of all ECM used either en route to or at the objective.

(C) The advance force uses ECM as prescribed in paragraph 10.3.3 for self-protection and protection of friendly forces. Control responsibility remains with the CATF.

(C) The advance force uses ESM to gain additional information about the enemy. One of the most important tasks of the advance force is to obtain information which can be used in the location and destruction of electronic installations which serve the enemy in the objective area. During advance force operations, the assigned intercept guards search portions of the radio frequency spectrum for enemy transmissions. DF fixes are obtained, and signals are thoroughly analyzed. Where destruction is not accomplished, the data obtained may be used during later stages to facilitate jamming operations and aid in avoiding detection by enemy electronic systems. The data collected are disseminated to supplement prior intelligence concerning the objective area.

10.3.6 (C) Supporting Arms All EW equipped units in the amphibious objective area will be tasked with guarding certain threat emitter bands. Direct support naval gunfire ships will be assigned the secondary role of ESM. All screening and general naval gunfire support units will be assigned a primary additional task of intercept search. All EW reporting by these supporting units, as well as the amphibious ships, will be in accordance with procedures in Appendix E as modified by the CATF or higher authority. All units must be aware of the highly mobile radar control weapon systems that can be brought into the landing area by a potential enemy to disrupt ship-to-shore movement. Because of this threat, a fast and accurate DF capability and signal analysis are a necessity.

10.3.7 (C) ESM/ECM/ECCM in a Counterinsurgency Environment. Despite the fact that many assault landings in a counterinsurgency environment are not opposed, the requirement for an effective EW plan still exists. If an elusive insurgent is to be caught and defeated, he must be surprised. The concept of successfull counterinsurgency operations must, therefore, evolve around:

1. Detection of the enemy
2. Rapid and discrete planning
3. Surprises
4. Successful assault and mobilization or destruction of enemy's electronic capability.

It should be recognized that even in the counterinsurgency environment the enemy has the capability to monitor tactical circuits, particularly when operations are conducted over an extended period in one general area. Extreme care must be taken to counter the ability to monitor these circuits and to provide an effective authentication system in order to prevent deception.

10.3.8 (U) Consolidation and Retirement. While units of a naval amphibious task force withdraw from the objective area, the naval units and landing force units ashore in the objective area continue to conduct EW operations as required to carry out the assigned mission. All units render mutual support so long as the distance of separation permits. Responsibility for control and coordination of EW operations remains with the CLF. When mutual support is no longer possible, the CLF continues control and coordination in the objective area, and the OTC of the retiring naval units assumes responsibility for control and coordination of his force in accordance with the instructions in Chapter 2.

APPENDIX D

Bearing Problem

1. On a maneuvering board, lay out own ship's course and speed vector (110°T, 15 kt). Label e-r vector.

2. Plot bearings as obtained from intercept search equipment.

0800 – 000°T – Label Line "B1"
0900 – 349°T – Label Line "B2"
1000 – 336°T – Label Line "B3"

3. At any point on "B1" construct a perpendicular line (to "B1") that crosses bearing lines "B2" and "B3."

Intersection of Perpendicular Line and "B1" Line. Label, "P1"

Intersection of Perpendicular Line and "B2" Line. Label, "P2"

Intersection of Perpendicular Line and "B3" Line. Label, "P3"

4. Measure the length of line "P1" to "P2" and lay off this same distance from "P2" toward "P3." Label this Point "X."

5. From Point "X" draw a line that is parallel to the "B1" bearing line, until it intersects the "B3" bearing line. Label this Point "Y."

6. From Point "Y" draw a line through Point "P2" until it intersects bearing Line "B1." Label this Point "Z."

7. Parallel the "Z-Y" line to ship's course vector (e-r) and draw a line from r to m in the same direction as from "Z" to "Y."

(This is the first direction of relative motion and somewhere along this line (Point "M" when found) is target's course and speed).

To establish the second direction of relative movement, the ship must change course and/or speed so as to produce a good bearing drift.

8. Lay out own ship's course and speed vector (045°T, 20 kt) and label e-rl.

9. Plot bearings as obtained from intercept search equipment.

1030 – 327°T – Label Line "B4"
1130 – 302°T – Label Line "B5"
1230 – 273°T – Label Line "B6"

10. At any point on Line "B4" construct a perpendicular line (to "B4") that crosses line "B5" and "B6." Label points of intersection:

"P4" on the "B4" Line
"P5" on the "B5" Line
"P6" on the "B6" Line

11. Measure the length of the "P4" to "P5" line and lay off this same distance from "P5" to "P6." Label this point "X1."

12. From Point "X1" draw a line that is parallel to the "B4" bearing line until it intersects bearing Line "B6." Label this Point "Y1."

13. From Point "Y1" draw a line through "P5" until it intersects bearing Line "B4." Label this Point "Z1."

Figure D-1. Sample Single Ship Ranging Technique (Bearing Only) Problem

14. Parallel the "Y1-Z1" Line to own ship's course and speed vector (e-rl) and draw a line in the same direction as from "Z1 to Y1."

(Where the two plotted DRMs (lines layed off the e-r vector and e-rl vector) intersect is the contact's course and speed (C-164, SPD-12.6 kt).

(The following steps establish the contact's position).

15. From Line "rl-m", determine the contact's relative speed. (28.3 kt).

16. Find the relative distance traveled during the last three bearings (28.3 kt for 2 hr = 56.6 mi).

17. Lay off the relative distance (56.6 mi) from "Z1" to "Y1," and label the Point "A" (Use any arbitrary scale).

18. Parallel bearing Line "B4" to Point "A" and draw a line until it intersects bearing Line "B6." Label this Point "B."

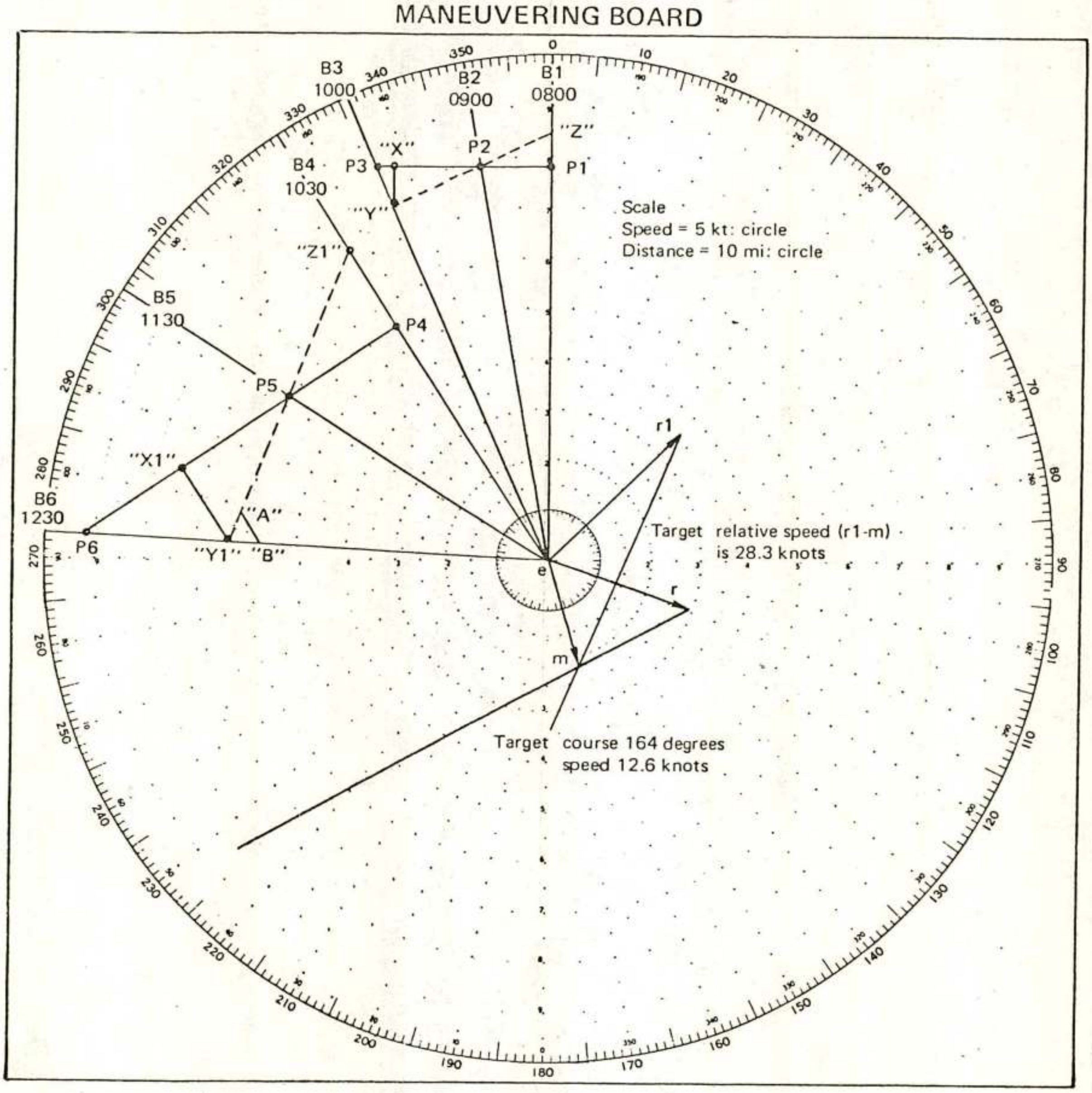
(This is the position of the contact at the time of the last bearing = 273^{O}T 58 nm. The range is measured from the center of the maneuvering board to "B," along bearing "B6" using the same scale that was selected for locating Point "A" (Step 17))

The preceding procedures are based on bearings which were taken at equal intervals. To accomplish the same objective with bearings taken at unequal intervals, establish the following proportion:

$$\frac{\text{(Time difference between "B1" and "B2")}}{\text{(Distance from "P1" and "P2")}} = \frac{\text{(Time difference between "B2" and "B3")}}{\text{(Distance from "P1" and "P2")}}$$

Cross multiply solving for the unknown distance "P2" to "X," the distance being measurable on the arbitrary scale that was used for measuring distance "P1" to "P2."

Figure D-1. Sample Single Ship Ranging Technique (Bearings Only) Problem (Cont.)



Note

When an airborne emitter is intercepted, the EWO must determine the specific platform by class, for example, Bear, and may estimate its speed based upon known intelligence. An aircraft's speed is usually so great that own ship may be considered, "DIW," and only one series of bearings need be taken to solve the problem.

Figure D-1. Sample Single Ship Ranging Technique (Bearings Only) Problem (Concl.)

APPENDIX E

Reporting

This appendix is identical to the Reporting appendix contained in NWP 32.

SECTION I – AAW

E1–1.1 (C) AAW REPORTING

(C) Air defense requires rapid, reliable and standard communications. As in other task group operations, reliable communications require a high state of material readiness and strict adherence to standard communications concepts and procedures. Standard procedures for AAW reporting are provided in this section, NWP 16, ACP 125, and ACP 165.

E1–1.2 (C) REPORTING RESPONSIBILITIES

E1–1.2.1 (C) Areas of Primary Responsibility. When sectors are not assigned, individual units are to assume an area of primary reporting responsibility from their own position outward away from the vital area center to the limits of their surveillance capability, overlapping the surveillance capability of neighboring units whenever possible. However, defense in depth considerations dictate full surveillance to the limits of surveillance capabilities at all times by all units regardless of sectors assigned or areas of primary reporting responsibility assumed.

(C) Normally, units only report contacts in their area of primary reporting responsibility. Whenever an unreported contact is detected outside a unit's area of primary reporting responsibility the unit must not allow that contact to remain unreported.

E1–1.2.2 (C) Assumption of Reporting Responsibility. Hand-off of reporting responsibility shall be made using the hold report. Procedures for use of this report are:

E1–1.2.2.1 (C) TDS Hold Report. (See paragraph E1–1.3.3.5.)

E1–1.2.2.2 (C) CAP Control Unit Reporting. Except for tracks reported on Link 14, a CAP control unit shall take over reporting responsibility of a contact when intercepting the contact with CAP. Thus, the unit with predominant interest in the bogey will be making position reports on the CAP and bogey that are correct in relationship to one another.

E1–1.2.2.3 (C) SAM Ship Reporting. Except for tracks reported on Link 14, a SAM ship shall assume reporting responsibility of a target which has been designated its missile target. Thus, the ship with predominant interest in the bogey will be making position reports that will be accurate with respect to the relative positions of the bogey and the SAM ship.

E1–1.2.2.4 (C) Contact Reported in a Fade. When a contact is reported in a fade, reporting responsibility for the contact will be assumed by any unit having the contact on radar. This will be accomplished by the unit having contact issuing a hold report. If more than one ship reports "Hold," the AAWC shall assign reporting responsibility to the unit best able to report and oppose the bogey.

E1–1.2.2.5 (C) Contact Passing the Reporting Unit Inbound. When a contact passes the reporting unit inbound toward the vital area or leaves the reporting unit's sector or area of responsibility (not outbound from the vital area), the reporting unit shall issue a "heads-up" report, which means "Enemy got through (part or all). Trouble headed your way." The report shall be addressed to the AAWC and to a unit closer to the vital area than the reporting ship or to a ship in the adjoining sector who shall then issue a hold report, completing hand-off of reporting responsibility. The unit issuing the "heads-up" report will continue to report the contact until a hold report is received.

E1–1.2.3 (C) Reporting Information on Other Units' Contacts. All units must attempt to supply missing data on any reported contact. Information on altitude and composition is particularly important.

E1–1.2.4 (C) Reporting by AEW Units. AEW aircraft will report contacts to the AAWC or other designated control ships.

When linking, the E-2 will make the same voice reports as other TDS units. When Link 11 is not used, all reports will be sent by voice over the primary AAW tracking net.

E1–1.2.5 (C) SITREP. At convenient lulls in AAW action, the AAWC should issue a SITREP of active bogeys, with any desired amplifying information. Position of the bogeys should be included when time permits.

E1–1.2.6 (C) LAAW Procedures. Ships having a secondary AAW capability, in company with an AAW ship, will be assigned an AAW voice call in accordance with Chapter 9. These ships will report contacts to the local AAW Coordinator (LAAWC) over the LAAWC net; polar coordinates will be used. The LAAWC will evaluate these reports and make reports to the AAWC using the primary AAW circuits. Information transmitted over this net includes:

1. Initial, tracking, and amplifying reports
2. SITREPs
3. Air raid warnings
4. CAP/weapons coordination of station units.

E1–1.2.7 (C) Reporting Criteria

E1–1.2.7.1 (C) Initial Report. Whenever possible, the initial report will be made after a thorough evaluation and will contain as much information (including weapon assignment) as possible. However, the report should not be delayed beyond the time required for the evaluation process and shall be sent without items of information that are not available once the evaluation decision is made.

E1–1.2.7.1.1 (C) Classification of Contacts. Evaluation of contacts shall be reported as one of four categories unknown, friendly, bogey or hostile.

1. An unknown is a contact for which the evaluation process has not yet been completed or one which the reporting unit has not been able to classify as friendly, bogey or hostile.

2. A friendly is a contact confirmed as a member of own or Allied force.

3. A bogey is an air contact which is unidentified but assumed to be an enemy.

4. A hostile is a contact positively identified as enemy.

(C) The evaluation must be as complete as possible. If the specific type of aircraft is known (such as one designated by a friendly voice call and side number or one designated by a NATO nickname), the most specific information available shall be used.

E1–1.2.7.1.2 (C) Contact Designation. Contacts shall be designated by the unit which made the initial report of the contact. The following designation methods will be used.

(C) Non-TDS units shall designate their contacts alpha-numerically regardless of category beginning at 0001 Zulu ("local time" if specified by the OTC). Each contact shall consist of a category, the single letter AAW call sign of the unit reporting the contact, and the contact number assigned sequentially since midnight.

(Example: Unknown ______ Three, the third contact reported by unit in station ______ since 0001 local; Racket ______ Seven, the seventh contact reported by unit in station ______ since 0001 local.) The letter-number portion of the designation retains the same alpha-numerical designation regardless of evaluation change. No number shall be reused by an individual unit during any 24-hour period.

E1–1.2.7.1.3 (C) NTDS/ATDS/MACCS Report. This report shall be a four-digit track number. When only one TDS unit participates, the four-digit track numbers are the computer track stores locator (CTSL), which begins with the digit "8" on Link 14. When more than one TDS unit participates, full track numbers are used; these track numbers may be processed by any or all TDS units and will print out on Link 14 with beginning digits "0" through "7".

E1–1.2.7.2 (C) Raid Composition. Raid aircraft flying in close formation or in such a manner that separate aircraft cannot be plotted as individual tracks will be reported as one raid. Composition shall be reported as one, few (two to seven), or many (eight or more).

E1–1.2.7.3 (C) Altitude Reporting. The altitude of threatening closing contacts is vital to proper evaluation and to timely initiation of intercepts. In addition to including altitude information in initial bogey reports, AAW units must call the attention of the AAWC to rapid changes in bogey altitude by terminating reports with the transmissions "climbing" or "diving."

(C) When reported altitude is determined from a fade chart, the pro-word "estimate" shall precede the altitude figure. Altitude information on a multiaircraft raid should include top and bottom limits.

E1–1.2.7.4 (C) Contact Fade Reporting. When a contact for which a unit has reporting responsibility fades from an AAW unit's surveillance radar but is held by fire control or CAP air intercept radar; a fade report shall not be made. However, when a contact is not held on any radar available to the AAW unit for three minutes, the AAWC must be informed.

E1–1.2.7.5 (C) Raid Split Reporting. If a raid splits, the designations of the separate parts of the raid are assigned separate designations by the unit which reports the split. The part of the raid which most nearly maintains course and speed retains the previously assigned designation. Other contacts or splits reported by non-TDS units will be assigned the next consecutive alpha-numerical designation of that unit. Those reported by TDS units will be given track numbers.

(C) If a Vampire splits from a raid, the raid will retain its previously assigned designation while the Vampire will be assigned the next unassigned alpha-numeric designation of a non-TDS reporting unit, or the next track number of a TDS reporting unit.

E1–1.2.7.6 (C) Low Flier Reporting. These targets are by their nature the most difficult to oppose. Reports should be sent immediately, with incomplete information if necessary, so that other units in the disposition have maximum warning of the attack. This is an especially vital report if the low flier is in the vicinity of the main body.

E1–1.2.8 (C) Friendly Tracking and Reporting Procedures. Friendly reporting includes two groups of aircraft:

1. CAP and other aircraft, under control of ships in the force, engaged in active AAW operations

2. Returning strikes, close support aircraft, COD, ASW patrol, and other aircraft.

The first group is reported regularly by controlling ships. The second group requires special reporting procedures.

E1–1.2.8.1 (C) Reporting of Returning Aircraft. Pilots departing the carrier are responsible for knowledge of the corridor(s) in effect, location and voice call of air control ships in the force, the TOMCAT or PIRAZ unit on duty, individual ships' tacan channels, and their proper IFF/SIF codes; they are responsible for accurate corridor navigation and meticulous compliance with friendly aircraft procedures.

(C) Aircraft with an emergency shall squawk "Emergency" and call any air control ship (preferably a TOMCAT or PIRAZ unit or a carrier) for control and direct routing to the parent carrier. Aircraft with inoperative tacan shall report this fact to the TOMCAT and request navigational assistance. The following procedures will facilitate reporting returning strike aircraft.

E1–1.2.8.1.1 (C) Use of TOMCAT, PIRAZ, and Approach Corridor. When permitted by strike missions, a TOMCAT or PIRAZ unit and an approach corridor should be employed to assist in identifying a returning strike. When tactical considerations require strikes at maximum range, returning strikes cannot be required to adhere to identification procedures which require additional fuel consumption. Under such circumstances, visual sighting and IFF/SIF procedures will be used for friendly identification.

E1–1.2.8.1.2 (C) IFF/SIF Identification. Returning aircraft shall ensure that when they are at least 150 miles from the TOMCAT or PIRAZ unit or nearest picket IFF/SIF is energized when feasible. Proper operation of IFF/SIF equipment and personnel proficiency in its use are mandatory.

E1–1.2.8.1.3 (C) Use of Identification Maneuvers. These maneuvers may be prescribed when approaching the TOMCAT or PIRAZ unit.

E1–1.2.8.1.4 (C) Reports on UHF. Reports should be made on UHF frequencies by returning strikes/friendlies to the TOMCAT or PIRAZ unit giving call, composition, heading, and altitude for identification, low fuel state, and any damage to aircraft.

E1–1.2.8.1.5 (C) TOMCAT or PIRAZ Unit Conduct Surveillance. The TOMCAT or PIRAZ unit conducts surveillance of returning strikes to prevent bogeys from attaching themselves to the friendly aircraft. When identified as friendly, they will be reported in accordance with the communications procedure in use.

E1–1.2.8.1.6 (C) Returning via Established Corridors. Returning aircraft proceed from TOMCAT or PIRAZ unit via established corridors through the missile zone(s) to the carrier landing pattern. Marshal point shall be positioned, insofar as practicable, on the low-threat side and shall be promulgated by the parent carrier.

E1–1.2.8.1.7 (C) Friendlies Not Able to Follow Prescribed Return Sector/Corridor. Friendlies should make the required identification maneuvers, show prescribed IFF/SIF, and call TOMCAT or PIRAZ unit if they are not able to follow the prescribed sector/corridor. They will be tracked and reported in accordance with the communications in use.

E1–1.2.8.2 (C) Reporting Other Friendly Aircraft. Outbound strike aircraft will not be reported but will be watched. When an outbound strike turns back toward ZZ, it will be reported in accordance with the communications procedures in use.

E1–1.3 (C) DECENTRALIZED CONTROL PROCEDURE

E1–1.3.1 (C) Concept of Decentralized Control Procedures

E1–1.3.1.1 (C) Coordination and Control. The decentralized control procedure employs one circuit, the SNIP net, between sector AAWs and the AAWC for coordination of the AAW action. The decentralized control procedure can be used only when control of weapons is delegated to sector AAWCs.

E1–1.3.1.2 (C) Reporting. The number of reports required may be made on one circuit (SNIP net) because of assigned sector defense responsibility and the decentralization of AAW authority.

E1–1.3.2 (C) Selective Use of Sectors. The decentralized control procedure may be used only when the AAW area is divided into sectors, with designated sector coordinators (SAAWCs). The sector designation should be the same as the letter voice call sign of the AAW unit acting as sector coordinator.

E1–1.3.3 (C) Samples of SNIP Transmissions. The examples of transmissions given in this paragraph should not be considered as restricting the transmission of any information considered vital by unit evaluation, such as equipment casualties, electronic warfare reports, SAR information, and essential surface or subsurface reports in any understandable form. If procedures prescribed herein do not cover a specific operating requirement, initiative and common sense shall be used, with emphasis placed on brevity and clarity.

(C) Time shall be included as the last element in all reports that contain a track position; it shall be the time the track is at the position indicated, even if the reporting time is later than that of the position reported.

E1–1.3.3.1 (C) Initial Report. The initial report will include shipboard evaluation, bogey position, course, speed, altitude, and weapons system assignment.

Example: "This is ______ bogey ______ Six, Red 060/060, course 250. speed 450, altitude 35,000, CAP (Birds), time 05, over."

Example: "This is ______ ,Vampire, BRG 153, Over."

E1–1.3.3.2 (C) Engagement Report. This report is to be issued only in the event that there were no weapons assigned when the initial report was made.

Example: "This is ______ Track 1023, RED 040/040, (CAP) (Birds), time 10, over."

E1–1.3.3.3 (C) Amplifying Reports. These reports are not required unless EW characteristics or initial evaluation change, contact alters course more than 20 degrees/speed 50 knots, and/or there is a change in altitude. The report will include an updated position of the bogey and the change factor only.

Example: "This is ______, bogey ______ Six, Red, 060/060, course 270, speed 500, altitude 30,000, time 15, out."

Example: "This is ______, Vampire ______ Seven, White 005/080, course 265, altitude 16,000, time 15, OUT."

Example: "This is ______, Track 1023, Split, Track 1030, composition ONE, RED 038/015, course 185, altitude 33,000, time 13, over."

Example: "This is ______, BOGEY ______ SIX, Split, Vampire, ______ Nine, Red 040/065, course 230, speed 725, altitude 25,000 Birds, time 07, over."

E1–1.3.3.4 (C) Splash/Grand Slam/Heads-Up Report. This report is to be sent by the reporting unit when a raid is splashed, grand slammed, penetrates the picket line, enters an adjoining sector, or when a raid cannot be engaged. Grand slam reports are authority to remove subject raids from the system. Position reported in the grand slam is the position of the CAP.

Example: "This is ______ grand slam track 0336. Switchbox 201, Red 030/030, time 18, over."

When the raid is destroyed by missiles, no position is transmitted.

"This is ______, grand slam bogey Six, Birds, over."

"(Call sign AAWC), this is ______ heads up unknown track 0242, Red 060/010, time 20, over."

E1–1.3.3.5 (C) Hold Report. This report is to be issued by a ship having contact on a track after the reporting unit has lost contact.

Example: "This is ______ hold unknown track 0232, Red 050/010, time 21, over."

"This is ______, hold friendly ______ Seven, Red, 090/080, time 26, over."

E1–1.3.3.6 (C) CAP Position Reports. These reports are made after the CAP is under close control of assigned control unit. Controlling units will not report CAP positions unless CAP is outside

of his assigned sector. When CAP is steered, controlling unit will send position reports of the CAP every three minutes until the CAP is under control of his carrier.

Example: "This is ________ Switchbox 201, BLUE 020/080, time 16, out."

"This is ________ Switchbox 201, steered, BLUE 080/060, time 16, out."

E1–1.3.3.7 (C) CAP State Report. This report will not be sent unless a relief is required as determined by the controlling unit's evaluator. The first three digits of the report are the fuel state in hundreds of pounds. The fourth digit indicates semi-active missiles available. The fifth digit indicates passive missiles available and sixth digit indicates PHOENIX missiles available. Ammunition and oxygen will be reported only when critical. The time reported shall be the time the pilot transmits the state report to the controlling unit.

Example: "This is ______, state Silverkite 201, 055112, time 44, request relief, over."

E1–1.3.3.8 (C) Request CAP Launch. The AAWC will send this request to the CV when he deems it necessary. Sector AAW coordinators desiring CAP send request to the AAWC.

Example: "(Call sign AAWC) this is ______, request CAP, over."

"______, this is (Call sign AAWC), launch CAP for ________ control, over."

E1–1.3.3.9 (C) CAP Launch Report. The CV will send this report when the relief CAP is airborne. CV continues position report until picket assumes control.

Example: "______, this is ______, Switchbox 202, Blue 020/060, for your control, button 12, time 23, over."

E1–1.3.3.10 (C) Assumption of Control Report. The control ship broadcasts this report when it assumes control.

Example: "This is ______, I have control of Switchbox 202, over."

E1–1.3.3.11 (C) TOMCAT Procedures. The ship assigned as TOMCAT will report returning strike aircraft positions after they have been identified as friendly and when flight crosses the picket line.

Example: "This is ______, Battle Cry 310 flight of (TN), White 110/020, course 190, speed 250, angels 29, time 35, over."

E1–1.3.3.12 (C) Friendly Report. No reports will be made on friendlies until they leave detecting ship's sector.

Example: "(Call sign AAWC), ______ this is ______, friendly track 0416, Red 040/020, course 070, speed 350, time 11, over."

E1–1.3.3.13 (C) AEW/ASW Position Reports. AEW aircraft position reports will be handled in the same manner as CAP position reports.

(C) When ASW aircraft are operating in conjunction with a task force, the ASWC or the controlling authority will be responsible for keeping the AAWC informed of their position when within 200 miles of ZZ or within the surveillance area as designated by the OTC.

Example: "______ this is ______, Overpass 763, Blue 060/060, time 25, out."

"This is ______, I have control of Overpass 763, time 30, over."

E1–1.3.3.14 (C) CAP/Missile Coordination. The AAWC must have overriding control in ambiguous situations.

1. Bogey is being taken by adjoining sectors:

Example: "______, this is (call sign AAWC), bogey ________ ONE taken by ______, Birds tight, resume, over."

2. If the AAWC is in opposition to an engagement report he may change it.

Example: "This is ______, track 0511, Red 040/040, CAP, time 10, over."

"This is (call sign AAWC), resume, track 0511 Birds, over."

3. If the AAWC desires to hold engagement in abeyance.

Example: "This is (Call sign AAWC), resume, weapons tight, bogey ______ Seven, over."

E1–1.3.3.15 (C) Assuming Net Control

Example: "This is (call sign AAWC), ______ assuming net control time 28, authentication is DB, over."

E1–1.3.3.16 (C) SITREPS. The AAWC will order SAAWCs to give sitreps of their respective sectors. This report should be ordered during lulls unless it is evident that the need for the sitrep justifies interrupting a busy circuit. Contact positions will be given only when specifically requested.

Example: "______, this is (call sign AAWC), sitrep, over."

"This is ______, __________ Six, ______ Eight, track 0234, 0567, time 10, over."

E1–1.3.3.17 (C) Fade Report. When a contact has faded for more than three minutes, the position and time of the fade will be reported to the AAWC.

Example: "(Call sign AAWC), this is ______, track 0222 faded, Red 015/175, time 32, over."

(C) If bogey continues in a fade for five minutes, or the bogey's DR position is at the picket line, the reporting unit shall issue a scrub order.

Example: "This is _______, scrub unknown track 0335, long fade, out."

E1–1.3.3.18 (C) Nuclear AAW Warning Procedures. The procedures for warning friendly forces of imminent nuclear burst are intended primarily to minimize the potential eye hazard. Immediate burst effects (blast, nuclear, and thermal) should be minimal if the detonation is outside operational stand-off ranges. In view of the presupposed extensive distances between friendly units, only radio voice procedures will be considered.

E1–1.3.3.18.1 (C) Normal Procedures

1. When the decision to employ nuclear AAW weapons against a target is made by the AAWC, the information will be passed to the designated firing unit(s) on the SNIP Net.

Example: ______, this is (call sign AAWC - Roman Candle Bogey Track 094 White 020 Tack 020 Over."

"This is _________ Roger Roman Candle Bogey Track 094 White 020 Tack 020 OUT."

Meaning: Missile ship with AAW call sign _______ has been ordered by the AAWC, call sign Alfa Whiskey, to intercept bogey. NTDS Track 094 presently located at grid coordinates White 020-020 with nuclear AAW weapons (Roman Candle). The missile ship will acknowledge by repeating the order verbatim.

2. If the tactical situation permits, the AAWC will parallel Roman Candle warnings to the force on all other available tactical nets.

3. Upon receipt of a Roman Candle warning, each friendly unit within 100 miles of the target should take the following actions:

— Air controllers. If the tactical situation permits, vector all aircraft to a heading of 180° relative to the blast point. Warn pilots by transmitting "PREP Roman Candle" with the true range and bearing of the target from the aircraft.

— OOD/PRIFLY officer. Pass the word for all persons to take cover and standby for a nuclear flash port/starboard.

— Pilots. Increase cockpit lighting, close thermal shield, use eye protective devices such as monocular eye patch, fixed density filter (gold-coated visor) or photochromatic goggles.

4. When the nuclear missile is launched, the firing ship should broadcast the firing on all available circuits:

Example: "This is ______ (Ben Hur) - Roman Candle Away Bogey ______ Two (Track 094) White 017 Tack 020 Out."

5. Approximately 15-20 seconds prior to intercept, the firing ship shall broadcast the following over all available nets:

Example: "This is ______, (Ben Hur) Sunburst Sunburst -- Standby Flash Out."

Upon receiving "Sunburst," pilots and flight crews not equipped with eye protective devices should shield their eyes and maintain shield for at least 5 seconds following the receipt of "FLASH."

E1–1.3.3.18.2 (C) Emergency Procedures

1. It is highly likely that late hostile detections or raid density will preclude detailed warning transmissions as noted in item 1 of paragraph E1–1.3.3.18.1. In such instances, the abbreviated warning will be transmitted:

Example: "____, This is (call sign AAWC), Roman Candle Bogey ______ Two Northwest Now Break Whiskey Over."

______ will acknowledge receipt first:

Example: "This is ______, Roger ______, Two Northwest Out," and immediately commence paralleling firing and intercept information on all other nets. All other units (collective call Whiskey) will acknowledge the Roman Candle and commence taking protective measures. Priority should be given to vectoring all friendly aircraft away from the blast.

E1–1.3.4 (C) EW Reports in the Decentralized Control Procedure. ESM and ECM coordination/reporting will be conducted on the SNIP net or as otherwise directed by the OTC.

EW reporting procedures are outlined in Figure E-2, section II of this appendix.

E1–1.4 (C) CENTRALIZED CONTROL PROCEDURES

E1–1.4.1 (C) Concept of Centralized Control Procedure

E1–1.4.1.1 (C) Control. The centralized control procedure may be used in any AAW environment. It is a method of reporting all raid and engagement details that enables the AAWC to exercise control of tracking and weapons employment. It uses the AAW(R) and the AAW(C) nets.

E1–1.4.1.2 (C) The AAW(R) Net is used for:

1. Tracking data (including initial contact, position reports and sitreps)

2. Tracking coordination and orders (including TDS coordination, hold reports and scrub orders)

3. EW intercept and jamming reports

4. Gridlock

5. Unidentified submarine contacts

6. Air raid and nuclear weapons employment warnings.

E1–1.4.1.3 (C) The AAW(C) Net is used for:

1. Command orders (including scrub orders and changes in ESM and radar guard assignments)

2. Contact evaluation (including bogey and passive intercept evaluations)

3. Weapons systems employment (including take orders and state and sugar reports)

4. Friendly aircraft assignment (including CAP/AEW assignments)

5. Control of SAR efforts (including both surface and air) and homing or lost aircraft

6. Air raid warnings.

E1–1.4.2 (C) Single Net Procedure For Centralized Control. The tactical situation may at times require that centralized control procedures, combining AAW(C) and AAW(R) functions, be used on one frequency. This modified use of the centralized control procedure must not be confused with the decentralized control procedure which uses the SNIP net. When use of the centralized control procedure on one frequency is required, the AAWC should consider relaxing centralized control procedure reporting requirements.

(C) Requirements which may be relaxed include but are not limited to:

1. Frequency of tracking reports of bogeys (AAWC discretion)

2. Friendly position reports

3. Scrub orders (grand slam reports are authority to remove raids from system)

4. Initial contact reports normally reported on the AAW(C) net.

E1–1.4.3 (C) Samples of AAW(R) Net Transmissions. The examples of transmissions in this article should not be considered as restricting the transmission of any information considered vital by unit evaluation, such as equipment casualties, EW reports, SAR information, and essential surface or or subsurface reports in any understandable form. If procedures prescribed herein do not cover a specified operating requirement, initiative and common sense shall be used with emphasis placed on brevity and clarity.

(C) Time shall be included as the last element in all reports that contain a track position: it shall be the time the track is at the position indicated, even if the reporting time is later than the time of the position reported.

E1–1.4.3.1 (C) Initial Report. This is the first report on a contact. The initial report will include course and speed when available.

> "(Call sign AAWC), this is ______, bogey ______ FIVE, RED 060/185, course 100, speed 480, time 24, over."

E1–1.4.3.2 (C) Tracking Report. When an intercept is not being conducted, subsequent tracking report will be submitted for every 30 miles of bogey track (every 3.8 minutes at speed Mach 0.8) or whenever the bogey changes course by 20 degrees or more, or changes speed by 60 knots or more, or changes altitude. If the bogey does not travel the required distance, or the course or speed characteristics do not change the required amount, the report will be updated at least every 5 minutes.

> "This is ______, bogey ______ Five, Red, 035/190, time 38, out."

E1–1.4.3.3 (C) Tracking Report During CAP Intercept. When an intercept is being conducted, CAP and bogey positions will be transmitted in the same report, commencing at the time the CAP is assigned to the bogey.

"This is ______, bogey ________ FIVE, Red, 035/190, Dakota 52, RED/005/085, time 28, out."

If either CAP or bogey are being broadcast over Link 14, this report will be omitted. However, information will be passed upon request of a unit or AAWC.

E1–1.4.3.4 (C) Fade Reports. When a contact has faded, it will be reported to the AAWC three minutes after the fade or at the next reporting interval, whichever comes first. The report includes the position and time of the fade.

"(Call sign AAWC), this is ______, bogey ______ FIVE, faded, RED 015/175, time 32, over."

E1–1.4.3.5 (C) Heads-Up Report. When an AAW unit is no longer in an optimum position to engage a contact, the following report will be made to the AAWC and to neighboring AAW units.

"(Call sign AAWC), ______, ______, this is ______, heads-up bogey ________ Five, Red 033/080, time 45, over."

E1–1.4.3.6 (C) Hold Reports (Non-NTDS). When a fade report is received, all units will check to see if the faded contact is held on their sensors. A unit holding the contact will make the hold report.

"(Call sign AAWC), ______, this is ______, hold unknown ________ Six, Red 020/160, time 33, over."

(C) Bogey course and speed shall be included in the hold report if they differ from the last report of the ship making the fade report, using the standards given in paragraph E1–1.4.3.1.

"(Call sign AAWC), ______, this is ______, hold unknown ________ Six, Red 020/150, course 120, speed 430, time 33, over."

E1–1.4.3.7 (C) Scrub Orders. When an entire raid has been destroyed (grand slam), the AAWC shall order the contact scrubbed. A scrub order may also be issued to resolve a dual designation. Reason for the scrub may be given. Scrubs by a TDS unit shall be paralleled over data links as drop track orders.

"Whiskey, this in (call sign AAWC), scrub bogey ______ Five, ______, over."

E1–1.4.3.8 (C) Tracking Sitrep. If time allows, the AAWC makes a periodic sitrep giving designations and positions of active bogeys NTDS track numbers.

"Whiskey, this is (call sign AAWC), tracking sitrep follows. Tracks 0314, RED 050/205, 0417 Red 080/105, unknowns 0320 ______ Six, White 005/075, 0431, Blue 120/000, time 41, out."

E1–1.4.3.9 (C) Friendly Position Reporting. Friendly contacts are reported on the AAW net following the category guidelines of Chapter 9. Reports will be submitted for every 60 miles of travel, or when the contact changes track by 20 degrees or more, or when the contact changes speed by 60 knots or more, or changes altitude. Air control ships shall commence position reporting on assuming control of the contact. Carriers shall commence reporting friendlies launched from their decks (excepting outbound strike aircraft) when the aircraft comes under control of the carrier CIC. Friendlies held by NTDS ships' sensors and transmitted on Link 14 are not reported unless a position report is requested by a non-TDS unit.

1. Initial Report "(Call sign AAWC), this ______ friendly ______ Six, Red 120/155, course 060, speed 360, time 17 out."

2. Subsequent Tracking Reports "(Call sign AAWC) this is ______, friendly ______ Six, Red 100/140, time 22, out."

E1–1.4.3.10 (C) Contact Redesignation Report. When a racket is changed to a radar contact or when a contact category is changed (that is, unknown to bogey and so forth), the following report is made.

"(Call sign AAWC), this is ______, racket ______ Eight redesignated friendly ______ Eight, over."

"(Call sign AAWC), this is ______, unknown ______ Ten redesignated bogey ______ Ten, over."

E1–1.4.4 (C) Samples of AAW(C) Net Transmissions. These reports are used by the AAWC and by unit evaluators to control and direct prosecution of the AAW effort.

(C) The examples of transmission in this article should not be considered as restricting the transmission of any information considered vital by unit evaluation such as equipment casualties, electronic warfare reports, SAR information, and essential surface or subsurface reports in any understandable form. If procedures prescribed herein do not cover a specified operating requirement, initiative and common sense shall be used, with emphasis placed on brevity and clarity.

E1–1.4.4.1 (C) Air Raid Warnings are promulgated by the AAWC to all units in the force. This may be accompanied by weapons condition in the orders.

"Whiskey, this is (Call sign AAWC). Warning (Red) (Yellow) (White), Weapons (Free) (Tight), over."

E1–1.4.4.2 (C) Initial Report. At the same time the initial report is being transmitted on the AAW(R) net, the initial AAW(C) net report is sent to the AAWC on the AAW(C) net.

"(Call sign AAWC), this is ______, bogey ______ Five, course 100, speed 480, altitude 28,000 composition few, over."

"(Call sign AAWC), this is ______, Vampire BRG 195, over."

E1–1.4.4.3 (C) Contact Redesignation Report. When a racket is changed to a radar contact or when a contact category is changed (that is, unknown to bogey, and so forth), the following report is made.

"(Call sign AAWC), this is ______, racket ______ Eight redesignated friendly track 0316, over."

"(Call sign AAWC), this is ______, unknown ______ Ten redesignated bogey track 0322, over."

E1–1.4.4.4 (C) Take Report/Order. When an air control unit desires to take a contact or when the AAWC desires to have an air contact, the take report or take order shall be used.

"(Call sign AAWC), this is ______, taking bogey ______ Five with Silverkite 43, over."

"______, this is (Call sign AAWC), take track 0417 with Silverkite 43, over."

(C) When the AAWC orders a unit to engage a contact for which the unit does not have reporting responsibility, the AAWC may include a position of the contact in the AC net take-over to facilitate initiating the engagement.

"______, this is (Call sign AAWC), take bogey ______ Five Red 050/125, with Silverkite 43, time 17, over."

E1–1.4.4.5 (C) Tally-Ho Report. When possible, a report of a contact sighting by CAP is made to the AAWC. The report will include contact altitude, composition, and identification (when available).

"(Call sign AAWC), this is ______, Dakota 52, Tally-ho bogey track 0313, altitude 29,000 composition three Bears, over."

E1–1.4.4.6 (C) Covering Report/Order. When an air control ship desires to cover a contact or when the AAWC desires to have an air control unit cover a contact, the cover report or cover order shall be used.

> "(Call sign AAWC), this is ______ , covering unknown ______ , Nine with Switchbox 22, over."

> "______, this is (Call sign AAWC), cover unknown track 0223 with Switchbox 22, over."

E1–1.4.4.7 (C) Skip Order. When the AAWC desires to have an air control ship break off an intercept, the skip order is used.

> " ______, this is (Call sign AAWC), skip bogey ______ Four, over."

E1–1.4.4.8 (C) No Joy Report. When the interceptor is unable to make any visual or radar contact with the bogey, the AAWC must be informed; the AAW unit's intentions will be given in the same transmission.

> "(Call sign AAWC), this is ______ Dakota 52 NO JOY unknown track 0321, continuing, over."

E1–1.4.4.9 (C) Missed Intercept Report. If the interceptor misses the intercept, this report will be made to the AAWC. Intentions will be included in the report.

> "(Call sign AAWC), this is ______, Dakota 52 missed intercept unknown track 1232, continuing, over."

E1–1.4.4.10 (C) Splash Report. When only part of a raid is destroyed, the AAW unit shall report engagement results to the AAWC, together with intentions (resuming, salvoing, heads-up) and identification of contacts when available.

> "(Call sign AAWC), this is ______ Splash one hostile track 0315, (Birds) (Dakota 52), heads-up two Badger Bravo, over."

E1–1.4.4.11 (C) Heads-Up Report. When an AAW unit is no longer able to engage a contact, the following report will be made to the AAWC and to neighboring AAW units.

> "(Call sign AAWC), ______ , ______, this is ______, heads-up bogey track 0533, over."

E1–1.4.4.12 (C) Grand Slam Report. When the entire raid has been destroyed, grand slam shall be reported to the AAWC, giving the weapon used.

> "(Call sign AAWC), this is ______, Grand Slam track 0531 with (Birds) (Dakota 52), over."

This report will be followed by a scrub order on the AAW(R) net and by a drop track message on Link 14.

E1–1.4.4.13 (C) Resuming Report. When a CAP is ordered to return to station, the following report is made to AAWC. This report may be combined with the grand slam, splash, missed intercept, or heads-up report.

> "(Call sign AAWC), this is ______ , Dakota 52 resuming over."

E1–1.4.4.14 (C) CAP Launch Report. The carrier shall report all CAP launches to the AAWC and air control ship. The AAWC may make or change CAP assignments on receipt of the report. (See comments in paragraph E1–1.4.4.16.)

> "(Call sign AAWC), this is ______ , Dakota 52 airborne, button 12, over."

E1–1.4.4.15 (C) CAP Assignment. The AAWC shall assign CAP to AAW units for control. If the carrier has informed the AAWC of the aircraft assignments for the CAP launch and the AAWC has informed the carrier of CAP assignments before the CAP launch, then the CAP assignment will be included in the CAP launch report by the carrier. Elements of the assignment message are CAP voice call and side number, CAP station number or position, CAP assigned altitude, and CAP control net frequency/button number.

"______, this is (Call sign AAWC), your CAP Dakota 52 track 0413, Station Red 005/025, angels 28, button 12, over."

"(Call sign AAWC), ______, this is ______, Dakota 52, Station Red 005/025, angels 28, button 12, airborne for ______ control over."

E1–1.4.4.16 (C) Control of CAP. When the controlling unit assumes close control of CAP, the AAWC must be notified. At the same time a position report of the CAP will be sent on the AAW(R) net.

"(Call sign AAWC), this is ______, I have control of Dakota 52, over."

E1–1.4.4.17 (C) CAP State Report. This report is sent by the controlling unit when requesting a relief CAP, when CAP is steered, on expenditure of a weapon by CAP, or when requested by the AAWC. The first three digits of the report are the fuel state in hundreds of pounds; the fourth digit indicates semi-active missiles; the fifth digit indicates passive missiles available and the sixth digit indicates Phoenix missiles available. Ammunition and oxygen will be reported only when critical. The time of the report shall be the time the pilot transmits the state report to the controlling unit.

"(Call sign AAWC), this is ______, Dakota 52 state 095222, time 15, over."

E1–1.4.4.18 (C) Salvo Order. When the AAWC has authorized firing of a surface-to-air missile and friendly aircraft are near the bogey, the AAWC or the missile ship will order friendly aircraft away from the bogey. CAP control ships will report the direction in which their CAP has been salvoed.

"Whiskey, this is (call sign AAWC), salvo track 0434, ______, over."

"(Call sign AAWC), this is ______, Switchbox 201 salvoed West, over."

(C) The AAWC may direct the salvo order to one particular unit or CAP, the AAWC may specify the direction in which the friendly is to travel.

"______, this is (call sign AAWC), Salvo Dakota 52 north away from track 0555, over."

E1–1.4.4.19 (C) CAP Off-Station (Steered) Report. When a CAP leaves station for any reason other than to intercept a bogey, an off-station report shall be made to the AAWC. Usually the report will be that the CAP is on a steer.

"(Call sign AAWC), this is ______, Dakota 52 steered, state 025200, time 30, over."

E1–1.4.4.20 (C) Scrub Orders. When an entire raid has been destroyed (grand slam), the AAWC shall order the contact scrubbed. Reason for scrub may be given.

"Whiskey, this is (call sign AAWC), scrub bogey ______ Five ______, over."

SECTION II – EW

E2–1.1 (C) EW REPORTING

(C) Electronic warfare requires rapid, reliable and standard communications. As in other task group operations, reliable communications require a high state of material readiness and strict adherence to standard communications concepts and procedures. Standard procedures for EW reporting are provided in this Section, ACP 125, and ACP 165. Figure E-1 defines common EW reporting terminology.

(C) The objective of EW in support of fleet operations is to effect detection and permit timely reaction to an airborne, surface, or subsurface threat. Therefore, rapid and efficient reporting procedures are essential if EW information is to be useful on , force level.

E2–1.1.1 (C) Coordination During Naval Warfare Operations. During naval actions, the force commander has a vital need to integrate and correlate EW information into the tactical situation. When equipment limitations preclude a separate EW coordination and control net, EW information will be passed on the appropriate AAW net.

Transmissions will contain:

1. Intercept guard assignments
2. Racket reports and evaluations
3. EMCON control and coordination orders
4. EW equipment casualty reports
5. Orders to employ ECM
6. Reports of enemy use of ECM.

E2–1.2 (C) TACTICAL EW REPORTING CONTROL

(C) The EWCS is responsible for overall control of EW reporting. To aid in detection, identification, and quick reaction to the threat, the OTC will direct the use of ESM and ECM. The EWCS shall:

1. Receive all reports of intercepted signals and take action on each intercept reported.

2. Switch units with DF capabilities to the frequency of the intercept for Trouting.

3. Plot all reported DF bearings to obtain position, course, and speed of the emitter platform.

4. Identify and evaluate the intercept by ordering Rent reports.

5. Disseminate to the OTC and other units without delay all information on the intercept regarding evaluated threats and unknown.

6. Take action to scrub an intercept when information is no longer required or the intercept is no longer active. Unless otherwise directed, ensure that all units resume previous guard assignments.

E2–1.2.1 (C) Tactical EW Basic Reporting Procedures. In many instances, the response time to react to a threat is so short that immediate action must be taken to neutralize or eliminate the threat. It is, therefore, imperative that the OTC be made immediately aware of all intercepted signals evaluated as non-friendly for purposes of quickly and effectively ordering appropriate countermeasures and placing ships in appropriate conditions of readiness. (See Figure E–2.) Basic reporting procedures to be used are:

E2–1.2.1.1 (C) Vampire Report (Missile Emergency)

1. Transmitted regardless of EMCON condition in effect only when emitter has been evaluated as terminal guidance for an ASCM.

2. NATO nickname (STYX, SEPAL, and so forth) or ASCM designation (SS-N-7, SS-N-12, and so forth) shall be provided.

3. True bearing to and frequency of emitter shall be provided.

TERM	MEANING OR USAGE
AFFIRMATIVE GRID	Transmitted to Duffers when control desires to have Duffers include their position along with any reports.
AMPLIFYING REPORT	Report which may be made by a Duffer at any time and which contains data that will assist other operators in finding the target on their equipment.
BRIDGE	Pulse width in microseconds.
BRUSH	Antenna rotation/scan rate in seconds per revolution (SPR).
CANYON	Use electronic jamming on frequency indicated or in accordance with previous orders.
CHATTER	Communications jamming.
CLIFF	Jamming signal (hostile/unknown/friendly).
CONFETTI	Chaff lane or corridor.
CONTROL	The unit responsible for coordinating intercept search efforts.
CURVE	Deception signal - hostile/unknown/friendly.
DUFFER	DF-equipped unit.
EMERGENCY	Report of an intercepted emission that is considered to indicate an immediate threat to the force or unit.
FORD	Assume intercept guard/watch on band or guard indicated.
FREAK	Frequency in MHz.
GADGET	Radar or emitter equipment (type of equipment may be indicated by a letter as listed in operations orders). May be followed by a color to indicate state of jamming. Colors will be used as follows: GREEN - Clear of jamming AMBER - Sector partially jammed WHITE - Noise jamming RED - Sector completely jammed BLUE - Completely jammed BLACK - CW jamming PINK - Partially jammed through 360 degrees
GRIDIRON	Jamming signal appears on my PPI scope or jamming prevents determination of range and bearing ____ percent of the time.
HOOTER	Jammer.
INTERCEPT GUARD	Frequency band to be assumed by designated unit.
MUSIC	Electronic jamming (hostile, friendly, or unknown).
NEGATIVE GRID	Transmitted to Duffers to cancel the requirement to report position along with contact reports.
NEGATIVE REPORT	Transmitted to control when the Racket to which a Duffer has been assigned is not detected.
NEGATIVE TROUT	Transmitted to control when the Racket to which a Duffer has been assigned is detected but a bearing cannot be obtained.
RACKET	Intercepted electronic emission which is unidentified but assumed to be enemy and which has been assigned a serial number.

See note at end of figure.

Figure E-1. (C) EW Reporting Terminology (Sheet 1 of 2)

TERM	MEANING OR USAGE
RACKET CEASED	Announcement that the intercepted signal source has ceased or paused in emitting.
RACKET NUMBER	Number assigned to an intercept emission to be used as a reference to the emission in the future.
RACKET REPORT	Report made by a Duffer to control and containing best bearings and other pertinent data.
RENT REPORT	Report of characteristics of the intercepted signal, given in the following sequence: (1) frequency (2) pulse repetition rate, (3) pulse width, and (4) antenna rotation rate in SPR. These parameters are separated by the word TACK. Any unknown portion of the sequence must be represented by the word UNKNOWN.
REVERT	Resume search on the previous intercept guard (watch).
SCRUB	Erase racket specified from all plots. Duffers automatically revert to last guard assigned without further order.
SEARCHER	Unit having intercept equipment without DF capability. All references to duffers are applicable to searchers within their capabilities.
SLOPE	Pulse repetition rate in pulses per second.
SPIKE	Bearing of a single jamming transmission is ____ degrees T.
SPOT	Used in conjunction with prearranged code numbers designating spot frequencies to direct stations on the intercept frequency with the use of UP and DOWN _____ MHz.
SWITCH	Order telling the designated ship or ships to cease general searching and shift to the frequency of the specified Racket, whether or not the Racket is within the Duffer's intercept search responsibility.
TROUT	Take a DF bearing on transmission indicated.
TROUT RACKET	Order for indicated Duffers to take a bearing on indicated rackets.
VAMPIRE	Hostile missile terminal seeker.
WATCH	Order to a Duffer (not necessarily the one originally intercepting a signal) to continue search in the assigned intercept guard but to check bearing and characteristics of designated Racket when passing its frequency and report any significant changes.

NOTE: A complete list of terminology is provided in Operational Brevity Codes, ACP 165

Figure E-1. (C) EW Reporting Terminology (Sheet 2 of 2)

SITUATION	REPORT
VAMPIRE REPORT (MISSILE EMERGENCY) 1. Any EMCON plan 2. Emitter evaluated as terminal guidance for ASCM 3. NATO nickname or ASCM designation required 4. True bearing and frequency required	(Collective Call) THIS IS____, VAMPIRE (NATO Nickname or ASCM Designation), FREAK____, BEARING____, I SAY AGAIN.... OUT
EMERGENCY RACKET REPORT 1. Any EMCON plan 2. A direct ASCM threat to the force has been assessed 3. NATO nickname or ELINT notation required 4. True bearing and frequency required	(Collective Call) THIS IS____, EMERGENCY RACKET____, (NATO Nickname or ELINT Notation), FREAK____, BEARING____, (EWCS Call).... OVER
RACKET REPORT 1. Depending on EMCON restrictions 2. Unknown or unfriendly emitter 3. Frequency and true bearing required 4. Evaluation by key number when identified	(Collective Call), THIS IS____, RACKET____, FREAK____, BEARING____, KEY____, (EWCS Call).... OVER
TROUT REPORT Organizing a Trout – Control takes action to fix location of Racket. Although not specifically named, the ship initially reporting the Racket is included as a Duffer.	____THIS IS (EWCS Call) SWITCH RACKET____, STAND BY TO TROUT, TIME 18 OUT
Ordering the Trout – Time 18 control desires Trout.	THIS IS (EWCS Call) TROUT RACKET ____ OVER
Reporting the Trout – Duffers report results of Trout, reporting in alphabetical sequence of voice calls (only the first Duffer's report is given here as an example).	THIS IS____RACKET____, 180 OUT or THIS IS____ RACKET____, NEGATIVE TROUT OUT or THIS IS____ RACKET____, NEGATIVE REPORT OUT
RENT REPORT 1. Reported only when requested by control. 2. Contains frequency, pulse repetition rate, pulse width, scan bearing and time (4 digit) in that order. Frequency: 9120 MHz PRF: 1100 PPS PW: 0.5 US Scan: Circular/10SPR Bearing: 060 T	____, THIS IS (EWCS Call) RENT RACKET____OVER. THIS IS____, RACKET____ RENT 9120, TACK 1100, TACK 0.5, TACK ALFA 10, TACK BEARING 060, OUT.
Racket ceased – Racket ____ ceased timed 26.	(EWCS Call), THIS IS ____, RACKET____, CEASED TIME 26, OUT.
Racket resumed – Racket ____resumed time 27.	(EWCS Call), THIS IS____, RACKET____, RESUMED TIME 27, OUT.
Revert: Ordering continued watch on Racket – Control decides that a particular Racket is not an immediate threat but still needs watching and desires other units resume search.	____, THIS IS (EWCS Call), REVERT, BREAK, ____ WATCH RACKET____, ____, OVER.
Racket Scrubbed – Racket ceased for 5 minutes the EWCS will issue a Scrub to the force.	(Collective Call) THIS IS (EWCS Call) SCRUB RACKET____, TIME 29, OUT.

Figure E-2. (C) EW Reporting Procedures

CLASSIFICATION	BEARING ACCURACY
A	$\pm 2^0$
B	$\pm 5^0$
C	$\pm 10^0$
D	$> \pm 10^0$
Q	SNAP

Figure E-3. (C) Classifications of Bearings

E2–1.2.1.2 (C) Emergency Racket Report

1. Transmitted regardless of EMCON condition in effect only when, based upon the tactical situation and geographical location, the evaluated emitter has been assessed as the direct threat to the force.

2. NATO nickname (SCOOP PAIR, PUFF BALL, and so forth) shall be provided.

3. True bearing to and frequency of emitter shall be provided.

E2–1.2.1.3 (C) Racket Report

1. All unknown or unfriendly emitters will be transmitted under this report depending on the EMCON restrictions in effect

2. Frequency and true bearing to emitter shall be provided.

3. Evaluations will be by KEY NUMBER obtained from NIS-1700-S-002 (YR); however, an evaluation is optional if it cannot be determined immediately.

E2–1.2.1.4 (C) Trout Reports

1. EWSC shall take immediate action to localize the source of any Racket reported through organizing, ordering, and plotting Trouts.

2. Trouting units (including EWCS will report either:

(1) True bearing to emitter

(2) Negative Trout

(3) Negative report

3. Bearings will be classified in accordance with Figure E–3.

E2–1.2.1.5 (C) Rent Report

1. If the EWCS requires additional fingerprint information on a particular emitter for evaluation purposes, he may request a Rent report from the reporting unit.

(1) It should be noted that Rent reports are lengthy and could tie up an R&T circuit unnecessarily.

(2) Present Rent report format set forth in ACP 165 makes no provision for reporting intercepts other than those using a circular scan. Units intercepting and identifying an emitter employing a scan other than circular shall include in the Rent report additional information using the appropriate single letter code and numerical value for the unit of measurement as indicated in Figure E–4.

E2–1.2.2 (C) LAMPS EW Reporting. The light airborne multipurpose system (LAMPS) comprises a ship/helicopter system designed to increase the capabilities of FF/FFG/CG ships by serving as an extension of the ship's sensors A limited ESM capability is provided by the installed AN/ALR-54 which is a modified AN/ALR-45 crystal video ESM receiver. The receiver incorporates threat warning logic to identify the ASCM threats listed in Figure E–5. Relative bearing and signal strength is provided by the receiver tactical display unit (TDU) which is monitored by the copilot.

(C) All LAMPS ESM intercepts are reported to the LAMPS control ship. Reports should include:

1. Proword to indicate priority (Vampire, Emergency Racket, Racket)

2. Threat indicator

3. Relative bearing

4. Aircraft heading

5. Time of report.

Sample reports are contained in Figure E—6.

E2—1.2.3 (C) Tactical EW Reporting via Data Link. Computer technology has greatly improved the efficiency in coordinating EW operations. With real-time relay of information through the use of data links, the problem of voice relay of tactical information has been drastically reduced. All TDS-equipped units exchange data via Link 11, and NTDS units pass data to non-TDS units via Link 14.

(C) ESM information which can be transmitted over Link 11 includes:

1. NTDS track number of fix or bearing

2. Bearing of emitter

3. Fix position in X-Y coordinates

4. Threat evaluation

5. Emitter platform (air, surface, subsurface, land, unknown)

6. Emitter identification number

7. Frequency

8. Pulse repetition frequency

9. Jitter

10. Pulse width

CODE	BASIC SCAN TYPE
A	Circular or rotating
B	Horizontal sector (bidirectional)
C	Vertical sector (bidirectional)
D	Steady
E	Irregular, unsteady, or manual
F	Conical tracking
G	Lobe switching
H	Tracking other than F or G
J	Raster
K	Spiral
L	Helical
N	Circular and conical
O	Sector and conical
Q	Helical and conical
R	Other combinations
S	Vertical sector (unidirectional)
T	Horizontal sector (unidirectional)
U	Unidirectional (plane undetermined)
V	Bidirectional (plane undetermined)
Z	Undetermined

Figure E-4. (C) Scan Types

11. Scan type

12. Scan rate

13. Polarization.

(C) ESM information which can be transmitted over Link 14 includes:

1. Track number of fix

2. Fix position in X-Y coordinates

3. Fix ID

4. Fix category.

ESM bearing lines and fingerprints are not transmitted on Link 14.

THREAT DESIGNATOR	THREAT
A-1	SS-N-3A seeker (sublaunched)
A-2	SS-N-3B seeker (cruiser launched)
A-3	AS-2/SS-N-2 seekers
A-4	AS-1/SSC-2b guidance radars or AS-2 mid-course control radar
A-5	SSM fire control radar on Soviet ships
B-1	FRONT PIECE radar SS-N-3A associated
B-2	SCOOP PAIR radar SS-N-3b associated
B-3	AS-5/SS-N-7 seekers
B-4	AS-2/AS-3 mid-course/command radars
B-5	SQUARE TIE radar SS-N-2/SS-N-11 associated (High PRF)
C-1	DOWN BEAT radar AS-4 associated
C-2	PUFF BALL radar AS-2 associated
C-3	AS-1/SSC-2b guidance/control radars or MUSHROOM radar
C-4	BANDSTAND radar SS-N-9 associated
C-5	BIG BULGE radar BEAR D or HORMONE B associated
D-1	APQ-72 radar used for tests and exercises
D-2	SHORT HORN radar AS-5 associated
D-3	CROWN DRUM radar AS-3 associated
D-4	SQUARE TIE radar SS-N-2/SS-N-11 associated (Low PRF)
D-5	Air search radars associated with SS-N-1/SS-N-3b ships

Figure E-5. (C) LAMPS Threat

EVENT	TRANSMISSION
Lamps station "SIERRA ONE" detects terminal radar of an SS-N-3b on ALR-54, bearing 245 degrees relative with signal strength reaching the second ring on his TDU. The helicopter is flying a magnetic course of 300 at a time reported with the word "VAMPIRE".	"THIS IS SIERRA ONE/VAMPIRE/A2/BEARING 245/HEADING 300/TIME 25/OUT".
Lamps station "SIERRA ONE" detects a MUSHROOM radar from a BADGER B on the ALR-54, bearing 300 relative with signal strength reaching the 1st ring on the TDU. The helicopter is flying a magnetic course of 255 at time 1833.	"THIS IS SIERRA ONE/EMERGENCY RACKET/ C3/BEARING 300/HEADING 255/TIME 33/OUT".
Lamps station "SIERRA ONE" detects a HEAD NET C bearing 300 relative with a signal strength weak on the 3rd ring on the TDU. The helicopter is flying a magnetic course of 180 at time 1838.	"THIS IS SIERRA ONE/RACKET/D5/BEARING 300/HEADING 180/TIME 38/OUT".
Lamps station "SIERRA ONE" sends updated bearing and strength information on earlier reported intercept of a MUSHROOM radar at time 1823.	"THIS IS SIERRA ONE/EMERGENCY RACKET C3 NOW BEARS 310/HEADING 220/TIME 23/OUT".

Figure E-6. (C) LAMPS Reporting Procedures

(C) ESM intercept data received by ESM detection equipment aboard an NTDS ship is entered into the system manually. A special console consisting of a PPI and a data readout then displays the data visually to the operator. EW information which can be processed includes:

1. Racket bearing

2. Frequency

3. Pulse width

4. Pulse repetition rate

5. Scan rate

6. Racket characteristics which can include one of the following:

— Emission type (pulse, AM, FM)

— Jamming type (barrage, spot, sweep)

— Classification (fire control or lock-on)

7. Identification of emitter (friend, hostile, unknown)

8. Platform type of emitter (air, surface, subsurface).

(C) The NTDS EW console is capable of displaying several bearing lines simultaneously. This provides an accurate means of determining by triangulation the probable emitter location, and eliminates the requirement for a DRT fix. ESM fixes may be produced and transmitted via Link 11 and Link 14 through selective action by the ESM supervisor at his console.

(C) ESM intercept data is automatically entered into the ATDS system in the E-2C, and may be manually selected for transmission over Link 11. The E-2C ATDS consoles display all incoming EW fixes or bearing information on the scope face, and simultaneously display all electrical parameter and ID data on a separate CRT alpha-numeric display.

(C) The TDS is not limited to inputs from TDS units but can accept data (entered manually) derived from non-TDS reports. ESM data entered from non-TDS sources is displayed on the console as a bearing line originating from the non-TDS unit symbol and extending out in the direction of the emitter. Rackets may be redesignated as TDS track numbers by the FEWC.

E2–1.2.4 (C) Reporting Own Use of ECM. When own forces activate deception repeaters in response to an AAWC/EWC order or Vampire reports, no report is required. In other cases utilize Figure E–7.

E2–1.2.5 (C) Reporting Enemy Use of ECM. When own forces encounter enemy use of ECM, they shall report in accordance with Figures E–8 and E–9 designated over the tactical net.

E2–1.3 (C) STRATEGIC EW REPORTS

(C) Strategic ESM and ECM reports shall be submitted by fleet tactical units on receipt of any enemy or unidentified electromagnetic emission which is potentially significant beyond the immediate tactical situation. These reports are a valuable source of information for:

1. Evaluation of enemy electronic capabilities

2. Strategic planning

3. Guidance in the development of new equipment and tactics.

(C) In some cases, information of enemy capabilities in ESM and ECM may be useful for both tactical and strategic purposes. Both types of reports shall then be submitted.

(C) Strategic reports of enemy electronic capabilities which may aid in the development of new equipment or tactics are made by commanding officers to higher echelons. Collected data must be carefully logged to reduce errors in the reports submitted.

Round Stone THOMAS	Shipboard Deception Repeaters
2	Blip enhance
4	Inverse gain
6	RGPO
8	Swept audio
10	RGPO/IG
12	Wobbulation (SLQ-17 only)
Round Stone WILLIAM	Chaff projectiles or rockets (frequencies specified by frequency band designation)
Round Stone JOSEPH 1 2, and so forth	As stated in OPORD. Round Stone JOSEPH plus number will normally be used to designate airborne ECM equipment not otherwise designated.
Round Stone HARRY	ALQ-98
Round Stone ROSIE 1. CW 2. Narrow Spot 3. Wide Spot 4. False Target 5. Hop 6. Jets 7. Sweep	ALQ-99
Round Stone NATHAN	ALQ-92
Round Stone GEORGE 1. CW 2. Narrow Spot 3. Wide Spot	ALQ-76

EXAMPLE REPORTS

SITUATION	REPORT
1. Unit with ULQ-6 is radiating equipment in inverse gain mode of operation against bogey ____.	THIS IS ____, ROUND STONE THOMAS FOUR SHINING BOGEY____OUT.
2. Unit with ULQ-6 equipment radiating in inverse gain mode of operation against bogey ________ evaluates DECM as ineffective.	THIS IS ____, ROUND STONE THOMAS FOUR NEGATIVE BOGEY____OUT.
3. Unit fires chaff projectiles (frequencies designated).	THIS IS ____, ROUND STONE WILLIAM INDIA SHINING, OUT.
4. Aircraft uses noise jammer. Noise jammer listed as "JOSEPH Two" in operation order. Direction of jamming orientation should be given (degrees true).	THIS IS ____, ROUND STONE JOSEPH TWO SHINING 180, OUT.

Figure E-7. (C) ECM Coordination Codes and Reporting Procedures — Own Use of ECM

SITUATION/ACTION	REPORT
1. Unit Detects use of ECM on sensors A. Make initial report 1. Cliff (Jammer) or Curve (deception) 2. Gadget (use Figure E-9) 3. Gadget color code (use Figure E-1) 4. Bearing.	A. THIS IS ____, CLIFF GADGET SIERRA, WHITE 090, OUT.
B. FEWC/AAWC desires additional information 1. Bearing (current) 2. Target correllation 3. Can unit a. Acquire targets? b. Engage targets?	B. ____ THIS IS (____), INTERROGATIVE CLIFF GADGET SIERRA TACK THREE, BRAVO OVER. THIS IS ____, THREE ALFA AFFIRMATIVE, THREE BRAVO NEGATIVE, OUT.

Figure E-8. (C) Reporting Enemy Use of ECM

SEARCH RADAR/FIRE CONTROL AREA SYMBOLS

Symbols to be used in reporting search radar/fire control radar over AAW nets are:

UNIT	SYMBOL
Primary air search	S
Secondary air search	Q
Height finder	O
Surface search	M
Primary fire control	G-(No. of systems affected)
Secondary fire control	H-(No. of systems affected)
Tertiary fire control	J-(No. of systems affected)

UNIT	SYMBOL
Tacan	A
ESM search	D ____ (Two numbers indicating upper and lower limits of frequency band in thousandths of Mega-Hertz)
ECM equipment (see ECM Coordination Codes in Figure E-7)	

MISCELLANEOUS ELECTRONIC EQUIPMENT STATUS

Symbols to be used in reporting miscellaneous electronic equipment over AAW nets are:

UNIT	SYMBOL
IFF	F
SIF	F1
IFF and SIF	F2

SYMBOLS FOR MISSILE SYSTEM STATUS

Symbols to be used in reporting the status missile systems over AAW nets are:

UNIT	SYMBOL
Primary Missile System	K ____ (Number of targets which can be simultaneously taken under fire.)
Secondary Missile System	L ____ (Number of targets which can be simultaneously taken under fire.)

Figure E-9. (C) Designation of Equipment on Voice Nets

DESIGNATORS	MEANING
A	Time up (Zulu)
B	Time down (Zulu)
C	Reason for terminating intercept
D	Signal number - a unique number identifying the intercept for future reference
E	Signal identification (use both radar nickname and SEDSCAF code)
F	Time of bearing, true bearing, bearing class or accuracy, signal-to-noise ratio, and position of intercept unit (in degrees and minutes of latitude and longitude during the time of intercept)
G	Radio frequency
H	Pulse recurrence frequency (PRF)
I	Pulse width (PW)
J	Scan type
K	Scan period - the period in seconds per cycle of the basic scan or the period of the lowest repetitive cycle of a complex scan
L	Illumination rate - the rate in Hertz for conical and lobe switching scan types or the highest cyclic rate of a complex scan
M	Polarization (if known)
N	Recording media - magnetic and/or photographic recordings made of the intercept signal. Magnetic recordings should be identified by reel number, cut number, and recording speed. Photographic recordings should be identified by reel number, frame number, and type of photography (that is, single frame, moving frame, or Polaroid)

Figure E-10. (C) Message Report Item Designators

E2–1.3.1 (C) Intercept Reports. Intercept information is of primary importance in any naval operation since it is the basis for planning active EW procedures. The tactical significance of such information is apparent; the strategic significance may require some study.

All enemy or unidentified emissions have strategic significance in that they are used to update the enemy EOB.

E2–1.3.1.1 (C) Written Report. This report containing intercept information shall consist of:

1. Forwarding letter containing an operational summary of the mission: it objectives, search plan, results, and recommendations
2. Operator's intercept logs
3. Magnetic tape recording
4. Films of analysis scope photographs
5. Films of photographs made of radiating antennas and platform on which installed (when available).

The written report shall be forwarded by air mail as indicated in the following paragraphs. The reporting procedure may be modified in special cases as CNO or the fleet commander directs. Units should refer to fleet commander's instructions in the 3430 series.

E2–1.3.1.2 (C) Message Report. In addition to the written report, strategic EW intelligence concerning new enemy electronic weapons, devices, techniques, or deployment will be reported by an appropriately classified message to the cognizant fleet commander for action, information to CNO, the cognizant ELINT Center, and other addressees as the CNO or fleet commander may direct. Unit should refer to fleet commander's instructions in the 3430 series. Figure E–10 lists report item designators. Figure E–11 provides specific guidance on categories to be reported and the action required by initiating unit.

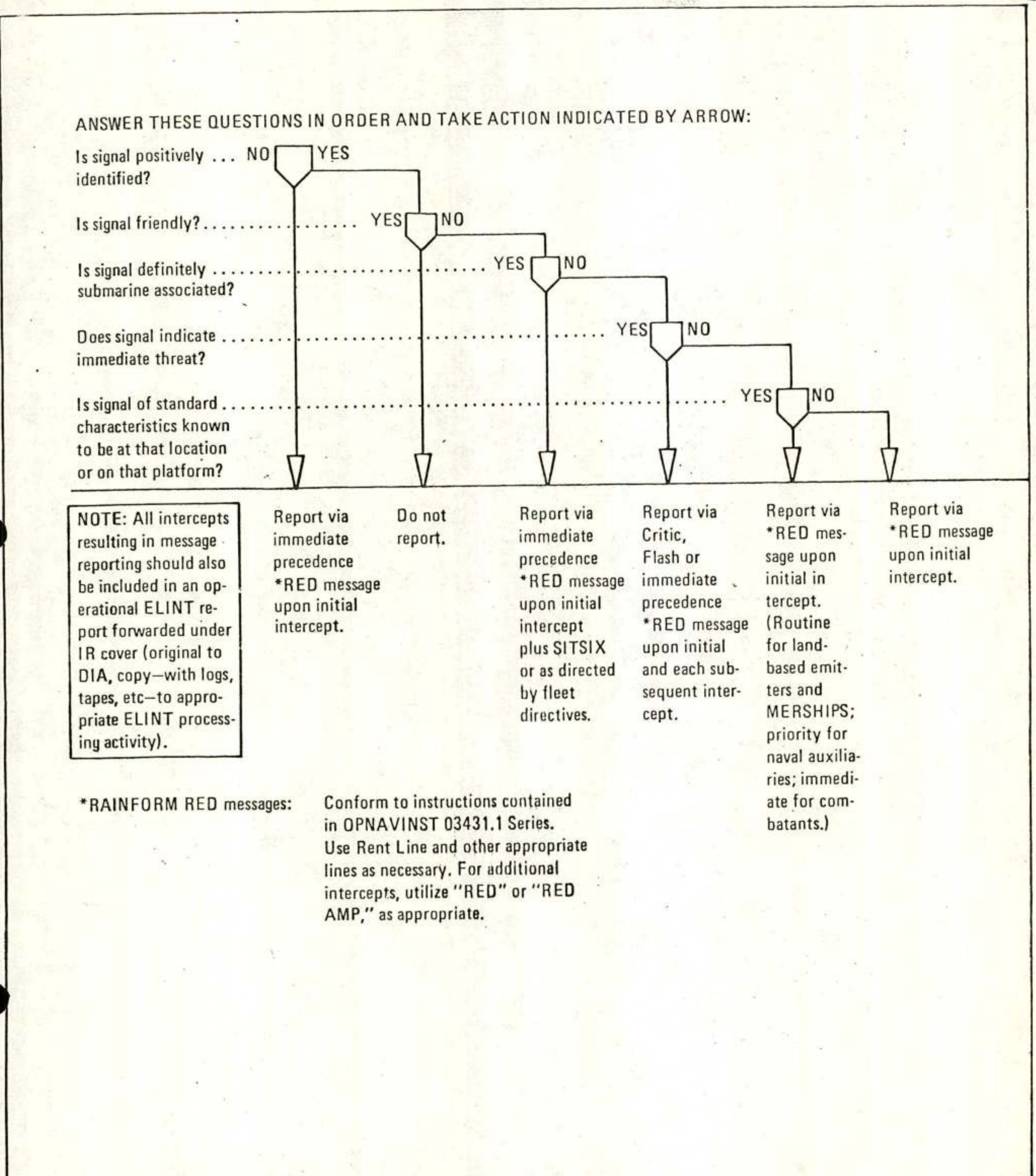


Figure E-11. (C) Message Reporting Guidelines

(C) Message reports will be forwarded upon acquiring:

1. Strategic EW intelligence concerning the enemy's new electronic weapons, devices, or techniques

2. Tactical EW intelligence of immediate concern to the conduct of the force/group tactical mission with particular emphasis on relocation of AAA, SAM, ASM, or SSM

3. Intercepts of suspected non-friendly submarine radars

4. Indications of an increased radar capability in an area

5. Information indicating an extensive redeployment of existing emitters.

E2–1.3.2 (C) Meaconing, Interference, Jamming, and Intrusion (MIJI). The JCS have established a joint service program for reporting incidents involving meaconing, intrusion, jamming or interference to the Air Force Electronic Warfare Center (AFEWC), San Antonio, Texas 78243. Naval commands will report MIJI incidents to AFEWC in accordance with OPNAVINST 3430.18 series. These incidents are evaluated by AFEWC and reported to the fleet in the following manner:

E2–1.3.2.1 (C) MIJI Hazard Warning. This is warning of an operational or safety of flight hazard as reflected by a MIJI incident report. This warning is sent to all agencies concerned by an immediate message within 24 hours of receipt of the incident report.

E2–1.3.2.2 (C) MIJI Evaluation of Individual Incidents. The Center's policy is to evaluate all reported incidents and return the evaluation to the reporting unit and other agencies.

E2–1.3.2.3 (C) MIJI Weekly. Summary of all incidents evaluated the previous seven-day period.

E2–1.3.2.4 (C) MIJI Quarterly. A compilation of selected MIJI events evaluated during the quarter, with emphasis directed toward trends development.

E2–1.4 (C) STATUS BOARDS

(C) The EW status board displays the radiation characteristics of important enemy signals which may be intercepted. Data are recorded during operations, and indications of the status and action taken as the results of reported data are also recorded. The status board shows a complete and up-to-date record of the radiation characteristics of all signals within the force and of all friendly and known enemy electronic equipment. The operational status of own equipment is shown, and, on the control ship, the status of capabilities of equipment of the force should be posted. The status board should also show the EMCON condition in effect and time sharing plans. Figure E–12 shows a typical EW status board. The tactical action officer (TAO) requires a display (status board) of the EMCON condition in effect and the time it was set or modified in order to ensure compliance. The display should include ownship ESM guard by frequency in order for the TAO to coordinate his data requirements against OTC/EWCS assigned guards. The TAO does not need to have the parameters of all intercepted signals; however, he does need enough information to identify and correlate the data to contacts held on radar. Figure E–13 shows a typical TAO EW status board.

EW STATUS BOARD

OIC		ELINT INFORMATION	REEL NO.	RECORDING NO.
EWCS			SIGNAL NO.	PHOTO NO.
EMCON	MOD			

SENSORS	UNQ-1
SPS 10E	URN-7
SPS 43	ULQ-68
SPS 48	COMM
MK-10	LF
SPG-50	HF
SPG-55	VHF
SOS 23	UHF
EW EQUIP STATUS	
WLR 1GB 1 2 3 4 5 6 7 8 9 10	
WLR 11	NT-66131 PORT STBD
SLR-12	NT-66132 PORT STBD
WLR 3A	AS-1174
WLA-3A	AS-1175
AM-4255	AS-571
SLA-10A	AS-616
CV-741	AS-8998
CV-742	UNO-7D
ULQ-6B PORT STBD	SLA-12 PORT STBD

SHIP	AAW CALL	DAILY CALL	RADAR GUARD	EQUIP

SHIP	INTERCEPT FM	GUARD TO	SHIP	INTERCEPT FM	GUARD TO	SHIP	INTERCEPT FM	GUARD TO

RK	FREQ	BRG	TIME	EMITTER	PLATFORM	THREAT	PRF	PW	SCAN	REMARKS

Figure E-12. (U) EW Status Board

TAO EW STATUS								
EMCON PLAN		TIME SET			INTERCEPT GUARD			
EWCS					HERO			
INTERCEPTS								
RAK	TN	FREQ	BRG	TIME	EMIT	PLAT	THRT	RMKS

Figure E-13. (U) TAO EW Status Board

SECRET

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